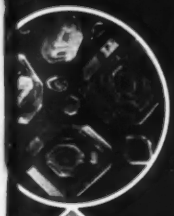
CHEMISTRY

MAR 2 1953



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Idle Play
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Idle Play

➤ PRINCE RUPERT, grandson of King James I of England, as befitted his station in life, was interested in the arts of war and peace. He was interested in the way ammunition was formed, in his day, by dropping melted lead down a "shot tower" into water. The round drops of liquid metal, cooled thus suddenly, formed the ball shot for muskets. Prince Rupert was also interested in the craftsmanship of glass making. The round drops formed when melted glass is dropped down a shot tower, instead of lead, were introduced by him into England, as an amusing toy, and have been known ever since by the name of "Prince Rupert's Drops."

Instead of the spherical form of lead shot, melted glass suddenly cooled takes on a tear-drop shape which tapers off into a long slender tail, as the viscous material falls through the water. The amusing thing about the drops is that the globular front part is hard and tough, so that it may be struck by a hammer without breaking, while the drawn-out fiber of the tail is under such strain that, when it is flipped off, the entire globule bursts into a mass of fine powder.

For at least three hundred years, Prince Rupert's Drops have amused the scientifically curious. Finally someone got up enough scientific curiosity to make a systematic study of the conditions that make glass hard *versus* the conditions that make it shatter. As a result, we have structural glass, safer windshields, transparent casings and many other adaptations which give us the useful properties of glass while by-passing its disadvantages.

Work with materials, within the limits of what they obstinately will and won't do, can be an interesting game in its own right. When the human mind can pit its ingenuity against these limits, and find a way to adapt a seemingly uncooperative material to a unique new use, accomplishment reaches a truly creative plane. One of the best ways to achieve such mastery over a material is just to play with it, to delight in its properties, as Prince Rupert did with his odd glass tears.

CHEMISTRY

Vol. 26, No. 6 — Formerly The Chemistry Leaflet Including The Science Leaflet — February 1953

Published monthly, September through May, by Science Service, Inc., the non-profit institution for the popularization of science. Publication Office: 119 South Frazier St., State College, Pa. Entered as second-class matter at the Post Office, State College, Pa., under Act of Congress of March 3, 1879. Address subscriptions and editorial communications to the Editorial Office: 1719 N Street N.W., Washington 6, D. C.

$4 a Year; Two-Year Subscription $7; Your Own and a Gift Subscription $7 a Year. 50c a Copy. Ten or more subscriptions to the same address: $2.90 a Year each. Subscriptions preferred for full volumes only, September through May inclusive; back copies sent. No charge for Foreign or Canadian Postage.

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Consulting Editor: PAULINE BEERY MACK (Editor 1927-1944)

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Science Service is the educational and scientific institution organized in 1921 as a non-profit corporation with trustees nominated by the National Academy of Sciences, the National Research Council, the American Association for the Advancement of Science, the E. W. Scripps Estate and the Journalistic Profession.

—Libbey-Owens-Ford Glass Co. photo.

➤ GLASS NOSES *and turrets for airplanes are flexible, tough and translucent because they are molded of fiber glass cloth laminated with plastic.*

Glass, the New Material

by HELEN M. DAVIS

➤ TINKLE and sparkle are still the words for glass, but modern glass is also a textile, a plastic and a building material. Can this be the same glass that came from the secret recipes of Venice, Rome or Egypt? Or has modern technology developed something new to replace the stuff that used to be a synonym for brittleness?

It would be easy to guess that modern glass is a new material, but actually the new pliable quality of the material is due more to the way it is handled than to radical change in the ingredients. True glass is still mostly sand.

It is true that modern technologists have taken glass apart and put it together again, with all the substitutions of similar materials that they could think of, to see what difference that would make in the properties of the resulting glass. In this way the new heat-resistant glasses were dis-

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—Libbey-Owens-Ford Glass Co. photo

➤ GLASS CLOTH, *loomed in Georgia and coated with resin in California, is wound on a roll preparatory to being processed into shape for airplane parts*

—Libby-Owens-Ford Glass Co. photo.

▶ TALL GIRLS *are preferred to work at these racks of glass yarn in the Fiber Glass factory of Libby-Owens-Ford at Parkersburg, W. Va., where cloth is woven from glass.*

covered. The important new ingredient in glass for cooking-ware is boron.

Earlier formulations stressed the relative proportions of soda, lime and silica as the main components of glass. Addition of lead oxide gave "cut glass" its distinctive brilliance and great weight.

"Crown" and "flint" are the technical names for glasses of opposite refractive index. One of the early triumphs of modern optical work was the combination of lenses made from these two types of glass, to correct aberration of light resulting from the optical characteristics of a single type of glass.

Clear and brilliant glass is often called "crystal." But chemists refer to another meaning of crystal when they discuss glass. They mean the way the atoms of glass line up. This is an important factor in transparency. Too many regularly spaced layers of atoms will reflect the light back and forth, making the substance appear opaque.

It is possible for the atoms of glass to form crystals of this kind. When that happens, the glass is said to be "devitrified." The effect is caused by cooling. For any single kind of glass, there is a temperature below which devitrification can take place and above which it cannot. This is like the formation of ice crystals in water. In fact, glass is found to be much more like a liquid than like other solids. It is often called a "supercooled" liquid, meaning one that has been cooled below its freezing point without crystallizing. More exactly, it is a substance which has a range of temperatures in which it is molten and flows like water, a lower range of temperatures in which it becomes

more and more viscous until it is hard and brittle, and a still lower range where devitrification can be made to occur.

Yet transparent glass has structure. Because beams of X-rays are bent by layers of atoms as they pass through any materials, it is possible to know quite definitely how the atoms in those materials are arranged. Glass studied in this way is found to be built up into a network by the forces that join the silicon and the oxygen atoms. Theoretically, therefore, other elements which combine with oxygen according to the same structural patterns should also form some kind of glass. Chemists have tried out such compounds, for two purposes.

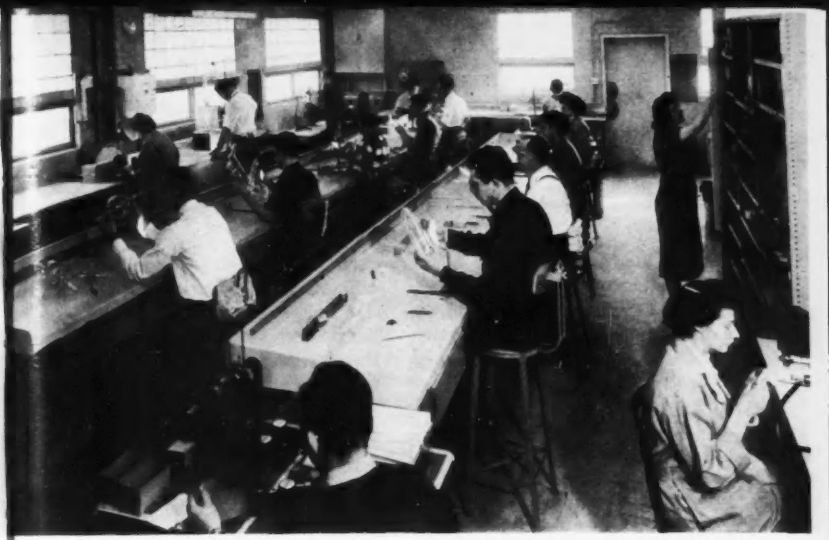
On the one hand, various kinds of antique glass have been analyzed to find out how the ancient glass makers, who learned by trial and error, produced the results for which they are famous. Then, when the ingredients have been accounted for, experimental glass makers have tried to reproduce the historic kinds of glass, for no chemist believes in the myth of a "lost art."

On the other hand, chemists have followed the laws of relationship between the chemical elements to build glass out of boron, germanium, phosphorus and even arsenic! While these efforts are classed as "pure research," admixture of boron has been found completely practical for heat resistant glass, and heat absorbing glass for motion picture projectors has been successfully formulated with phosphorus replacing part of the silicon. Glass containing no silicon at all has been made experimentally for research purposes where silicon could not be used because it would react with other substances present.

Combined with the silicon and oxygen of conventional glass, whether antique or modern, are sodium, calcium, aluminum and, unwanted but ever-present, the iron that gives cheap glass its greenish color. Many other elements are found along with these. Some, like manganese, are added to improve the color. Others just came along with the other ingredients. Such accidental accompaniments, of course, contributed greatly to the development of glass making through the ages, and must have been the source of many of the beautiful colors so characteristic of medieval windows.

In the cut-and-try era, it would become known that the sand from a certain locality would make glass with some unusual quality. Since the development of analytical chemistry, the unusual sand can be made to yield the secret that this quality is due to a particular element. The way this element enters into combination in the glass can now be determined, and, in the light of knowledge so amassed, special glasses can now be made as desired. Whether the purpose is lovely color, as is imparted by cobalt or gold, or detection of, or protection against atomic radiation, through addition of cerium or other rare earths, many special glasses are now readily available.

But, with any given formula, the properties of the glass will differ according to the way the molten material is handled and how it is cooled. Properly tempered, it forms windows, doors and structural units of surprising strength. Traditionally glass was blown by skilled craftsmen, a small



—Wakefield Industries, Inc., photo.

▶ HIGHLY SKILLED *glassblowers are still needed for specialized products. These experts, in Wakefield Industries' new plant at Skokie, Illinois, are fabricating scientific glassware to exact specifications.*

batch at a time. Now, borrowing methods recently developed for other plastic materials, not only is glass flowed from the furnace in an uninterrupted sheet, it is also squirted through nozzles to produce fine flexible fibers. In this form it is felted to form insulating material, or twisted into thread and woven into cloth.

Always valued chiefly for its transparency, glass now finds use for its other qualities as well. One of the most important of these is that it is fireproof. Upholstery and curtains of glass cloth furnish no fuel to the smoldering cigarette.

But as glass invades the territory of other materials, new transparent plastics are beginning to crowd it in the field it used to have for its own. Cellulose acetate, polyvinyl acetate and methyl methacrylate are among the materials transparent enough to be used in place of glass, or combined with it to help avoid the danger when glass shatters.

Beginning as "sandwich" layers to make automobile windshields safer, the combination of glass with plastic has now reached the stage where the two materials are bonded together with substances composed of "double-ended" molecules. One end of the molecule structure will combine with glass, the other with plastic. Together the laminated material makes light, strong, curved, translucent parts that are safe for the rigorous needs of airplane structure.

Color Television Tube, Better Scanning Devised

Nobelist Gets Two TV Patents

➤ DR. ERNEST O. LAWRENCE, Nobelist inventor of the cyclotron, and head of the radiation laboratory at the University of California, Berkeley, received a patent for a color television tube which has been hailed as a simple method of receiving color television broadcasts. The patent is numbered 2,614,231. Another invention applies to black and white T. V.

In his patent, number 2,619,612, Dr. Lawrence says that the present scanning method in television receivers tends to blur the line between light and dark areas in a picture. He would modify the deflection of the scanning beam in the direction in which the lines are scanned in proportion to the rate of change of illumination from point to point along the picture line. The deflection of the scanning beam would increase when the illumination is increasing and decrease when the illumination is decreasing.

With this method, Dr. Lawrence says, substantially full theoretical resolution of a television receiver may be sensibly obtained, and blurring of the edges of television images is reduced to a negligible minimum.

The patent is assigned to Chromatic Television Laboratories, Inc., San Francisco, Calif., to which Dr. Lawrence had previously assigned his method of color television.

On the Back Cover

➤ CHEMICAL GLASSWARE *is beautiful even though it presents a constant dishwashing problem to laboratory assistants, as in this scene from the workrooms of the General Electric Co. at Schenectady, N. Y. Special formulas create the kinds of glass that will stand up under the punishment chemists give their apparatus. General Electric estimates that its chemical department washes $3000 worth of glassware a week.*

Nerve Gases Feared As War Food Poison

Enemy Could Spoil Our Food Supply

EXTREMELY DEADLY nerve gases may be used to poison wartime food supplies, Dr. Thomas H. Alphin, chemical warfare consultant of the Federal Civil Defense Administration, warned the National Food and Nutrition Institute recently.

A few drops of the liquid form of nerve gases on the skin, if sufficiently concentrated, can cause death in a few seconds.

The highly toxic nerve gases are almost odorless, colorless and tasteless, and cannot be detected by the ordinary human senses until their deadly effects are felt. Contamination of food with nerve gases could kill hundreds of people before it is discovered and make great quantities of provisions unusable.

Nerve gases can be spread by mortar shells, artillery shells, rockets or aerial bombs. Besides direct attack, nerve gas bombs could be planted by saboteurs for contaminating stores of food and other goods, as well as for anti-personnel purposes.

The Federal Civil Defense Administration is developing a simple testing kit for use in detecting nerve gases and other chemical warfare agents, Dr. Alphin said.

Atomic and biological warfare may also be waged against food supply, the National Food and Nutrition Institute was told.

Dr. Vincent B. Lamoureaux, radiological defense consultant of the Civil Defense Administration, said atomic warfare will cause greatest damage to food supply in the initial blast and fire of the explosion. The tendency in American cities to concentrate warehouses and processing plants in the same area increases the danger here.

Radioactive contamination, however, is the new, unfamiliar result of atomic attack, and may make otherwise unharmed foods completely unusable and dangerous.

Biological attack, using insect pests and plant and animal diseases, may be used against our total food supply, said F. K. Erickson, acting chief of the emergency sanitation branch of the Civil Defense Administration. But bacteriological contamination of prepared foods as a weapon of war may be an even greater danger.

It is not unlikely, for instance, that saboteurs could place infectious disease germs in the food supply of large numbers of people, resulting in their sickness or death and the spread of disease.

Oleoresinous and resin-base types of paints can be scrubbed time and again without harm.

Atomic clocks, which are not expected to vary more than one second in 300 years, are regulated by vibrating atoms.

Foods Play New Roles
In Health and Disease

New Understanding of Nutrients

➤ LATEST ROUND in the fight over our bread and what may or may not be put in it apparently goes to the side that declares the natural emulsifiers, mono- and diglycerides, are safe.

The Food and Drug Administration, of course, had already decided these chemicals were safe. After extensive hearings, FDA permitted them in shortening in bread, in the bread standards which were to become official last August.

But that part of the bread standard was held up from enforcement by a court order because manufacturers of so called softeners, polyoxyethylene compounds, objected. The polyoxyethylene compounds were not permitted in bread by the new standards.

Dr. G. F. Dasher of the Proctor and Gamble Company, Cincinnati, announced first results of a new study of the naturally occurring emulsifiers, the mono- and diglycerides. His study shows that as much or more of these chemica's would be formed in the digestion and cooking of fats as would be put into bread. This is apparently the first time that boundary tension relationships have been studied in systems resembling those appearing during the digestion of fats.

The mono- and diglycerides give a quality called "tenderness" to bread and baked goods, according to trade circles. The polyoxyethylene compounds give "softness" so that if bread in the loaf is pinched, it feels like bread just out of the oven. This "softness" could be deceiving to the consumer, which is one reason why Food and Drug decided not to allow the softening compounds in bread.

B Vitamins and Antibodies

➤ CERTAIN B VITAMINS play a significant ro'e in the synthesis within the body of antibodies, the substances that help fight disease germs. The particular B vitamins for which such a role has been found are pyridoxine, pantothenic acid and pteroylglutamic acid.

Don't, however, rush out to buy a box of these vitamin pills with the idea of building up resistance to colds, influenza and the like.

How the findings are related to the general problem of nutrition and resistance or susceptibility to infection is not yet clear, Dr. A. E. Axelrod of Western Reserve University points out in reviewing his own studies and those of other scientists.

The problem will be cleared up, he says, when scientists show that the immune response to an infectious agent, or disease germ, is markedly affected in a given vitamin deficiency state and that this change in immune response is a vital factor in determining the resistance and susceptibility to the infection.

Vitamin antagonists, Dr. Axelrod suggests, might also be used to check the undesirable synthesis of antibodies, for example, those to the Rh blood factor.

Whether or not scientists ever reach the stage of saying a certain vitamin should be prescribed to build resistance to a particular disease germ, the ability to control antibody production in experimental animals by the vitamin intake should, Dr. Axelrod states, be a useful tool in the unraveling of the mechanisms of antibody synthesis.

Amino Acids for Polio

➤ A NEW LINE of attack on polio will be launched at the University of California at Los Angeles by Dr. A. F. Rasmussen, who will investigate the effectiveness of a synthetic amino acid — 6-methyl tryptophan — in studies supported by the National Foundation for Infantile Paralysis.

Previous experiments with mice have demonstrated that deficiencies of the natural amino acid, tryptophan, decreased the rate of paralysis in mice infected with the Lansing strain of polio, said Dr. Rasmussen. However, the tryptophan deficiency had an adverse effect upon normal physiological functions of the mice, and many died. This indicated that the polio virus was competing with the host for the limited amount of the amino acid available.

Later, said Dr. Rasmussen, it was found by substituting in the mice's diet a modified, synthetic form of tryptophan — 6-methyl tryptophan — the host was not seriously affected but virus growth was suppressed. This suggested that the host could tolerate the modified amino acid better than the virus.

The present study is designed to define the practical usefulness of 6-methyl tryptophan as a preventive measure against polio, particularly when oral infection occurs and at various stages of the disease. Much of the investigation will take place in Long Beach Veterans Hospital laboratories using monkeys as experimental animals.

Cortisone for Allergies

➤ DISCOVERY of the way cortisone, famous antirheumatism hormone, acts on body cells to relieve allergic disorders such as asthma, eye diseases and serum sickness was announced by Dr. Herbert R. Morgan of the University of Rochester, N.Y., School of Medicine and Dentistry at a recent meeting at the New York Academy of Medicine.

The hormone acts directly on allergic, or hypersensitive, cells to protect them from the substance that would poison the cells because they are oversensitive to it, Dr. Morgan found in studies with Robert H. Leahy, medical student.

Their study was made with cells growing in tissue culture outside the animal body. The cells selected for the study were from guinea pigs hypersensitive to tuberculin, used in skin tests for tuberculosis. Individual cells from these animals were subjected to tuberculin. Those that had first been treated with cortisone did not die although untreated cells did.

Anti-Rickets Chemical

➤ DISCOVERY of a new anti-rickets chemical was announced by Profs. Lester Yoder and B. H. Thomas of Iowa State College at the American Chemical Society meeting at Little Rock, Arkansas.

The new chemical, which is similar to vitamin D, is a brucine salt derivative of sulfonated cholesterol. It is known as 607 for short.

Compound 607 probably will not replace vitamin D in treatment or prevention of rickets but is expected to prove useful in study of how the D vitamins act to mobilize and translocate bone-forming substance.

Vitamin D is known to exist in 10 forms. Of these only D-2 and D-3 have practical importance. D-2 is made by ultraviolet irradiation of ergosterol. D-3 is made by ultraviolet treatment of a cholesterol derivative, 7-dehydrocholesterol, which can be isolated from fish liver oils. The vitamin is also formed in the skin of humans and other animals upon exposure to sunlight.

Seeds in "Dance of Death"

➤ UNDER the microscope, nuclei of food storage cells of wild cucumber seeds have been observed to do a "dance of death" before they are consumed by the growing embryo in the seed.

Dr. Flora M. Scott of the department of botany at the University of California at Los Angeles has observed for the first time sudden, weird contortions among living nuclei of endosperm (food storage) cells in the wild cucumber plant. The movements resemble those of the ameba. Thread and ribbon-like tentacles shoot out from the nuclei, writhing in a peculiar fashion. Eventually the nuclei break up.

These cells commonly serve as food for the growing embryo in the seed, Dr. Scott points out. She thinks the contortions may be a process by which the cells make themselves more digestible for the embryo, as the movements seem to occur just before the cells are devoured.

Key to Energy

➤ HOW NUTRIENTS are converted into energy is a problem that may be answered by studying some curious half-animal, half-vegetable-like organisms, the phytoflagellates.

Dr. George Holz of the department of zoology at the University of California at Los Angeles finds that certain of the phytoflagellates meet their nutritional needs by photosynthesis as in higher plants, by ingestion of particulate matter as in higher animals, and in absorption of dissolved materials as in both. All of this group of plant-like animals are able to move around by means of whip-like structures called flagella.

Dr. Holz's study has been concentrated upon the acetate flagellates—so called because of their predilection for acetic acid as a source of energy. Members of this group are peculiar because they are unable to utilize glucose, the most universal source of energy, but are able to live in strong concentrations of fatty acids, alcohol and a wide range of acidity and alkalinity.

Smog's Oxidizing Makes Rubber Crack

➤ STANFORD Research Institute scientists found in their studies that smog has uncommonly strong oxidizing powers. Rubber in smog areas cracks in a relatively short time. The air contaminants are gases, solids and liquids. One of the large volume sources of contaminated air consists of more than 125,000 tons of exhaust from automobiles, trucks and buses in Los Angeles.

Marine Phenomenon Studied By Biologists and Chemists

Mystery of the Red Tide

by Dr. Harold J. Humm
Director, Oceanographic Institute, Florida State University.

➤ The red tide is not a tide and it is not really red. It is a term applied to an extremely abundant development of a tiny, one-celled, plant-like organism which secretes a poisonous substance into the water. Most scientists believe this organism is present, but relatively rare, in the waters of the Florida Gulf coast at all times.

But most of the time there are too few to have a harmful effect upon fish and other animals. Once in a great while water conditions reach a certain state that promotes the development of enormous numbers of these tiny organisms, and when this happens the poison they produce becomes concentrated enough to kill.

The organism belongs to a group that is neither plant nor animal, but is intermediate in nature. However, it possesses chlorophyll as do true plants. Marine scientists classify it as a dinoflagellate, *Gymnodinium brevis*. It was first described by Dr. C. C. Davis of Western Reserve University, Cleveland, who studied it during the 1946-47 outbreak.

During autumn, water conditions off the lower west coast of Florida occasionally reach a certain, precise state that promotes the rapid development of *Gymnodinium brevis* that results in enormous numbers forming patches in the water, in which there may be 50 to 75 million per quart of water.

The water at first develops a yellowish hue which darkens to an amber color with a reddish tinge as the organisms increase. At the same time the water becomes remarkably thick and stringy.

While the conditions that promote the development of this organism in such numbers are not known, it is believed that rivers which drain phosphate-rich land of southwest Florida may be an important factor in view of the phosphates they contribute to the Gulf in the red tide area.

The chemical nature of the poison that red tide organisms secrete into the water is not yet known. It is believed to be a nerve poison. Fish are not killed by clogging of the gills or lack of oxygen. If asphyxiation is the cause of death, it is a result of the effect of the poison upon the nervous system and not because of mechanical interference with circulation of water through the gills.

The poisonous substance affects many other marine animals as well as fish. Invertebrates including barnacles, oysters, clams, shrimp and crabs are killed. There are reports that porpoises and sea turtles are also killed.

Toxicity of the water to man is shown by the nose and throat irritations that take place when an off-the-sea breeze prevails that exceeds 14 miles per hour. Under these condi-

tions, droplets of red tide water are blown into the air and inhaled by persons ashore. While the irritation produced is not serious, its cause is clear.

Sea water from which the red tide organisms were strained was just as toxic to fish as water containing the organisms. It was by this procedure that scientists proved that the organisms excrete a poisonous substance into the water.

Despite the large numbers of fish killed (an estimated half billion during the 1946-47 red tide period), there is no acceptable evidence that a significant proportion of the population is killed to make a detectable reduction in the population of the affected area. It appears that the loss of enormous numbers of game and food fish is of no direct economic importance.

There is an economic loss, however, by the fact that tourists, Florida's major "industry," are driven away from the beaches while dead fish are washing ashore or decaying.

In addition, the fishing industry suffers a loss because the demand for fish may be reduced during the red-tide period, and fishing may be curtailed. During the current red-tide development, winds have driven the dead fish out to sea. During November, at least, not enough fish washed ashore to affect normal use of the beaches.

Authentic reports of the red tide along the Florida Gulf coast are on record for more than 100 years. It is probable that the same organism has been responsible for almost every outbreak. On the average, the red tide has occurred once each decade but its appearance is very irregular and unpredictable.

Phenomena similar to the red tide are known all over the world. In California, one form of it is annual and renders the sea mussels inedible each summer. Probably the majority of red-tide phenomena which have been studied have been caused by an organism belonging to the dinoflagellates.

Mariners in the past have often mistaken discolored water for a shoal, which they reported to the hydrographic office as a menace to navigation, since it did not show on the chart.

The Florida red tide, if it behaves as before, may reappear during the winter. If this takes place, a thorough understanding of it should result, in view of the teams of scientists who are now in position to study it from every aspect.

Even False Teeth Need Good Diet

➤ A GOOD DIET is essential for good teeth — even false teeth.

On the right diet, mouths will be more comfortable and the false teeth will work better and longer, Dr. Dorothea F. Radusch of the University of Minnesota School of Dentistry declared at the meeting of the American Dietetic Association. This is because diet affects the gums and bone around the teeth as well as the teeth.

The basic rules to keep the mouth healthy are the same at all ages, she said. We all need to eat the highly nutritious meat, milk, eggs, butter, fruit and vegetables and whole grain and enriched cereals in proper quantities. We should all use sparingly the various kinds of sweets.

Billions Wasted When Science Application Slow

Report of a Year's Researches

➤ WORTH NOW three billions of dollars a year, the development of hybrid corn was ten years late because "practical" men failed to appreciate and develop the fundamental work carried out about three decades ago by Dr. George H. Shull in the Carnegie Institution of Washington's genetics laboratory.

This was charged by Dr. Vannevar Bush, president of the institution and war-time head of U. S. research, in his annual report.

We have no effective organization in the country as a whole for bringing the fruits of disinterested research to the point where they invite industrial development, Dr. Bush warned.

The most critical bridging of the gap between theoretical research and application at the present time concerns the green alga Chlorella. It will produce 56% dry weight of protein, of which the world is very short for food purposes. How can we realize on this discovery?

Magnetic Shift

➤ THE NORTH POLE will not stay put; it has shifted 12 feet in 30 years, to the perplexity of scientists.

But now Dr. E. H. Vestine, of the Department of Terrestrial Magnetism, Carnegie Institution of Washington, has hit upon the answer. From studies of the earth's magnetic field, Dr. Vestine said that the field has been drifting steadily westward, and that there is a corresponding westward movement of the upper layer of the earth's liquid core that accounts for it.

Besides this large westward drift, Dr. Vestine also found smaller crosswise drifts of the liquid core that exerted a force on the earth's axis.

Dr. Vestine explains it this way: the North Pole acts like a spinning top. The irregular forces from the transverse drifts act like a finger pushing against the base of the top. When this is done, the upper part of the top will move in the opposite direction from the push. Thus when the drifting earth's core pushes against the earth's axis, the pole shifts its position to oppose the force.

The momentum, or "push" of these transverse movements is adequate to explain the year-to-year variations of the pole's position, said Dr. Vestine.

Oldest Rock

➤ THE ATOMIC CALENDAR, holding the key to the age of the earth, has revealed more of its secrets during the last year.

Improved methods of radioactivity dating, being worked out at the Carnegie Institution of Washington, have led to the measuring of the oldest rock known so far to man. Granite rock from Manitoba, Canada, was found to be 3,500 million (3½ billion) years old.

Other ancient rocks dated by rubidium-strontium radioactivity measurements were from Bikita Quarry, Southern Rhodesia, 3,300 million; Jakkalswater, South Africa, 2,400 million; Ingersoll Mine, South Dakota, 2,100 million.

Dr. L. T. Aldrich and G. R. Tilton

of the Department of Terrestrial Magmetism, and G. L. Davis and L. O. Nicolaysen of the Geophysical Laboratory, reporting their joint work, told of promising new techniques in radioactivity dating.

Finding the age of rocks by their radioactivity depends on the constant rate of break-down of radioactive materials into various decay products. Uranium 238, for instance, will, through billions of years, finally decay completely into a lead isotope. Age of the material then can be found by comparing the ratio of it to its end product in a rock.

Up till now, only rarely-found concentrated ores could be used in dating. But by the new techniques, very small quantities generally distributed through granite rock can be measured and the rock dated.

Where only one or perhaps two determinations could be run on a single rock sample before, now, using the latest methods, many different substances can be analyzed from the same sample—thorium, uranium, lead, rubidium, strontium and potassium—each a check on the other.

This is made possible by separation of very small amounts of isotopes with ion-exchange resin columns, and their accurate measurement by the isotope-dilution technique and the mass spectrometer.

The resin columns are able to extract the smallest amount of an isotope from a mass of crushed granite. This tiny bit of material, which could not be easily or accurately measured by itself, is added to a larger known quantity of the same isotope. The effects of this small addition are then comparatively easy to observe and measure with the mass spectrometer.

This new method will allow far more different rocks to be dated than before possible, because it is not restricted to highly concentrated ores. It will also allow more samples of a single rock structure to be taken, thus affording a check. Also, it has been shown that radioactive materials distributed generally in granite show fewer age discrepancies than materials from ores.

Most of the previous work has been done with uranium and its lead end-products. More emphasis is now profitably being placed on the rubidium-strontium system. An advantage of dating with rubidium-strontium is that more varied granite minerals can be used than is the case with uranium-lead and some other radioactivity combinations.

The oldest rocks dated so far were found with the rubidium-strontium determination, using the isotope-dilution method of measuring.

Heredity Changed

➤ HEREDITY-CONTROLLING cell structures are only indirectly changed by mutation-causing agents (mutagens), Dr. M. Demerec, geneticist with the Carnegie Institution of Washington, has discovered.

Various chemicals and ultraviolet radiation used to cause changes in genes, bearers of hereditary traits, affect the general metabolism of a cell primarily. The changes in the gene follow as a result of the metabolism change.

Dr. Demerec described the process of induced mutation like this: A mutagen acts upon the cell material (cy-

toplasm) to cause a change in the cell metabolism. This change in the cell "climate" then affects the genes. Some of the genes are stable and do not react to the change, but others show some differences which then affect the hereditary structure of the cell.

Another discovery in genetics was that increased heat seems to speed up the process of mutation. Geneticist Evelyn Witkin found that the one-celled organism, Escherichia coli, showed a greater rate of both spontaneous and induced mutations with an increase in temperature.

Dr. Barbara McClintock reported she found that the carriers of genes, chromosomes, also bear another functional genetic unit. This second unit controls the time and degree of action of the genes.

Ghost Stars

➤ GHOSTS of dead stars that exploded hundreds of years ago and galaxies of stars in collision are sending out such strong radio signals that they have been picked up here on earth.

During the past year three of the outstanding radio sources of the sky have been identified by Dr. Walter Baade and Dr. R. Minkowski of Mount Wilson and Palomar Observatories of the Carnegie Institution of Washington and the California Institute of Technology.

Radio signals from the constellation of Cassiopeia were found to come from the center of a remarkable emission nebula. This is believed to be the expanding envelope of what may have been a supernova of the remote past.

Another strong radio source, located at the Cavendish Laboratory in England, is in the constellation of Cygnus, the swan. This was found to coincide with a galaxy of billions of stars like our own Milky Way, but far beyond the system of stars to which our sun and the earth belong.

This nebula is a very queer object. In fact, its structure seems to make sense only if it is assumed that we are dealing with two nebulae which are in actual collision.

Another strong radio source seems to be a mass of peculiar glowing filaments of gases, spreading out from the center at varying speeds. Except for its small size, this object in the constellation of Puppis, the ship's stern, resembles the one in Cassiopeia.

Drs. Baade and Minkowski have been cooperating with the active radio research centers in Australia and England in attempting to spot astronomical objects that are broadcasting the cosmic radio noise picked up here on earth. One of the first objects identified with a radio source was the Crab nebula, remnant of a galactic supernova of 1054 A.D.

Hard Metals Shaped Without Cutting

➤ EXTREMELY HARD metals which create problems in the machine shop now can be shaped more easily by an electro-mechanical process which tears particles from the workpiece without the use of a cutting tool.

M. F. Judkins, of the Firth Sterling Steel & Carbide Corp., has reported to the American Society of Tool Engineers that accuracies up to one-thousandth of an inch could be obtained with the new process.

Technical Developments Leading To Present Man-Made Fibers

Fibers For Specific Textiles

Extracts from an address by Joseph B. Quig, manager textile research division of E. I. du Pont de Nemours and Co., given at the symposium on New Synthetic Fibers at the St. Louis meeting of the American Association for the Advancement of Science.

➤ FOR HUNDREDS of years prior to the early 1900's, natural fibers, such as wool, cotton, flax and silk, had met the ever expanding requirements of service to the communities of the world; steadily, mankind, with great ingenuity, fashioned the natural fibers to wider and more exacting purposes. While the use of natural fibers for textile purposes dates back to antiquity, the first commercial production of man-made fibers is only some fifty years old. Still more recent is the manufacture of the true synthetic fibers.

Rayon and Acetate

Rayon was the first man-made fiber to attain commercial recognition by the textile industry; while acetate (formerly designated as a "rayon") was the second important manufactured fiber. Neither of these is synthetic in the true sense of the word. Cellulose, from which they are produced is an organic polymer synthesized by nature. Rayon made by the viscose process consists of regenerated cellulose, while acetate fiber is the product of interaction between cellulose and acetic acid. These two fibers are more accurately classified as regenerated man-made fibers, rather than synthetic; although the purist may dispute this classification of acetate.

In any event, both of these fibers, although relatively new, today are accepted in the family of textile fibers and a greater poundage of them is now consumed annually than of wool. In 1951, the world production of rayon and acetate totaled 3,957 million pounds; wool consumption in that year was 2,248 million pounds of clean fiber. The corresponding figures for non-cellulosic man-made fibers is 261 million pounds, the bulk of which is glass fibers and nylon. The initial emphasis with rayon and acetate was in wearing apparel, in which they achieved an outstanding success, principally because of their aesthetic properties and low cost.

New Objectives

For a quarter of a century, research on man-made fibers had been dominated with the idea of duplicating the natural fibers, especially silk and wool. A significant change, simple in concept, then occurred. No longer did the scientist focus his efforts toward the duplication of the natural fibers.

In the Marburg lecture, Harold DeWitt Smith prophetically gave the industry the objective for its next stage of development. He said, "The essence of this new philosophy is that fibers can be designed to meet specific textile wants, rather than design

ing textile wants to utilize immutable fiber personalities. . . . There is a wide and exciting horizon of the future, in which the only real limitations in the variety and characteristics of textile fabrics yet unborn will be the ability of the textile designer and technologist to help the fiber manufacturer understand what kinds of fibers are wanted." In the year 1930, this change in the philosophy of chemical and engineering research occurred in the rayon industry and subsequently set the pattern for the research on synthetic fibers. . . .

Fiber Formation

The early history of synthetic fibers is, in retrospect, dominated by the figure of the late W. H. Carothers. The basic research which he started in 1928 centered around a fundamental study of the synthesis and structure of large molecules, mainly by methods involving polycondensation processes. Until 1920, there was no generally accepted idea of what constituted a fiber-forming molecule. Mark, Meyer, Astbury and others, working with the X-ray method, showed conclusively that cellulose was crystalline and had a simple repeating pattern corresponding with the dimensions of a glucose unit. It was then possible to approximate the number of repeating units forming the macromolecular chain. Staudinger, working on the polymerization of formaldehyde, indicated that long polymer chains could be built up in a regular fashion from low molecular weight compounds, and that such polymers gave typical X-ray diagrams. The polymerization of vinyl compounds, such as styrene and vinyl chloride-vinyl acetate co-polymers, also showed the possibility of making long chain, high molecular weight polymers by the polymerization of simple organic compounds.

In 1927, Carothers began his work along the Brandywine in Wilmington, Delaware. His work centered around a fundamental study of the synthesis and structure of large molecules, mainly by methods involving polycondensation processes, in which it is possible to control the reaction and to obtain products of known structure. In traditional organic chemistry, side reactions can usually be neglected. The main product of a reaction is customarily purified by distillation, crystallization, or sublimation and the product from the side reaction is discarded. In high polymer chemistry, however, the total product is usually the end product. Consequently, the products of side reactions are embodied in the polymer structure and reflected in the fiber-forming properties. Carothers chose to work on linear polymers, avoiding the unnecessary complications produced by branched and cross-linked chains. To this end, he based his polymers on bifunctional intermediates, preparing a series of polyesters. He examined the aliphatic polyesters closely as a class, but they failed to attract his interest because of low softening point and susceptibility to hydrolysis. His work on linear superpolyesters, polyanhydrides and polyacetals led him to the polyamides containing nitrogen groupings similar to natural silk and wool.

Carothers' classical researches into the mechanism of the formation of high polymers gave an insight into the theory of condensation and of the

production of linear polymers from simple structures; on the one hand, by the simple conversion of a monomer into a polymer by addition polymerization, consisting simply of the union of several molecules with a redistribution of the valency bonds but with no splitting off of simple chemical substances; and by a second method of condensation, in which several monomeric units are joined together by the elimination of one structural unit, such as water, hydrochloric acid and ammonia.

Following these observations, Carothers prepared polyamides from a variety of amino acids and also dibasic acids. On February 28, 1935 (a new historic date), the high polymer from hexamethylene diamine and adipic acid was first synthesized.

$$NH_2(CH_2)_6\,NH_2 + HOOC(CH_2)_4\,COOH \rightarrow$$

$$[\ldots NH(CH_2)_6\,NHOC(CH_2)_4\,CO\ldots]_n + H_2O$$

nylon

The resulting polymer was melt spinnable and readily oriented by cold drawing to give lustrous fibers of good strength and flexibility. This polymer has been developed commercially here and abroad as nylon 66. It is so named because each of the bifunctional intermediates has 6 carbon atoms.

This period of early research was invaluable because it provided a basis upon which a number of clarifying principles of high polymer chemistry and fiber formation were founded. From the work of Carothers, Staudinger, Mark, Astbury and several others, it is possible to list the necessary requirements for an organic high polymer to attain fiber-forming properties:

(*a*) The polymer must consist of very large molecules, with a molecular weight exceeding 10,000 and an average chain length of over 1000Å in length.

(*b*) They must be linear and have a high degree of symmetry and absence of bulky side groups, so that good orientation can be obtained.

(*c*) The polymer must be capable of undergoing a high degree of orientation for the production of strong fibers.

(*d*) The polymer chains must have a high degree of polarity, produced by evenly spaced polar groups in the chain, to give good intermolecular cohesion, which leads to high melting point and the ability to maintain induced orientation.

The Nylon Process

The three main steps in the nylon process are (1) the preparation of the polymer; (2) spinning of the massive polymer to an unoriented, stretchable fiber and (3) the orientation and crystallization of the molecules in the direction of the fiber axis.

The preparation of the polymer proceeds in the following manner. The "double ended" adipic acid is reacted with the "double ended" hexamethylene diamine to form a salt. When this salt is heated, water is eliminated and a new compound is formed which contains the amide linkage. This compound also has an acid group on one end and a basic group on the other end. Each of these is free to react further. Thus, the chain grows in each direction. This

takes place approximately 100 times before the macromolecule is completed.

Although glass fibers have been produced by drawing out molten glass and solidifying them, one of the great engineering developments of du Pont research is embodied in the development of the melt extrusion technique for producing organic fibers. The melt spinning process developed for nylon can be applied to the production of filaments where the polymer is insoluble or not easily soluble in organic solvents and where the polymer will give, on melting, a viscous liquid without decomposition. Unlike the old processes of wet and dry spinning and the combinations of both processes, there is no problem of solvent recovery. In view of the higher temperatures used, the standard of engineering precision of the extrusion apparatus as a whole must be of high order and must be capable of filaments and fibers with tolerances in denier obtained by other methods of spinning using solutions of relatively low concentration of the high polymer. Unquestionably, this engineering development has had and will have in the future a profound effect on the diversity of synthetic fibers.

The viscosity of molten nylon makes it possible to extrude the material through small holes in a spinnerette to form filaments. These filaments solidify in the air below the spinnerette and are collected on a suitable package. Nylon filaments at this stage of manufacture are weak and stretchy and are of little value for general textile use, because the individual nylon molecules are coiled up and randomly oriented in the filaments. X-rays passing through the fiber are diffracted by the molecules and produce hazy circles on a photographic plate mounted behind the fiber. This type of diffraction pattern shows that the molecules in the fiber are completely unoriented.

In order to develop useful fiber properties, individual polymer molecules must be aligned. This alignment is accomplished by stretching the unoriented fiber. During the stretching operation, the fiber necks down and is permanently extended, becoming strong and elastic. Instead of hazy circles, we now observe a clear cut pattern of sharp spots and arcs on the X-ray diagram. This indicates that, as the fiber draws, the long molecules untangle as they slide past each other. The internal friction produced uncoils the chains and aligns them in the direction of the fiber axis. In many regions, these extended chains pack together in a crystalline lattice, but the X-ray pattern shows that the long chains never completely untangle. In some areas, coiled chains remain interspersed between the crystallites; these areas are the amorphous regions.

Fiber Properties

All of the mechanical properties of fibers are highly dependent upon the orientation and crystallization of the molecules. The degree of orientation and crystallization can be controlled in the process of fiber manufacture. From a single polymer, it is thus possible to prepare a family of fibers which differ among themselves in mechanical properties, all the way from ones which are weak and limp to those which are strong and stiff. However, the range of fiber properties

obtainable from a single high polymer is always limited, and it does not appear that any one polymer can meet all the requirements of the textile industry.

There are at least three elements in chemical structure which are important in determining fiber properties. These elements are: The flexibility of the molecular chains; the number, kind, and distribution of the attractive forces between the chains; and the nature of other groups along the chains.

The nylon molecule is a flexible chain of carbon atoms with amide groups interspersed along it at relatively wide intervals. The amide groups of adjacent chains are strongly attracted to one another by hydrogen bonds.

X-ray examination of polyethylene terephthalate fibers and related substances has revealed no evidence of strong intermolecular forces. Chain rigidity, induced by the p-phenylene linkage and perfection in packing of the chains, rather than strong interchain reaction, are the important factors influencing the properties of "Dacron" polyester fiber and "Terylene."

To summarize, elements of chemical structure, such as intermolecular bonding and molecular flexibility, can be combined with elements of physical structure, like orientation and crystallinity, to produce a different set of properties in each synthetic fiber. . . .

Fibers, Plastics, Rubbers

In research directed towards the development of new fibers, one of the first aims must be to build up thermally stable structures which are crystalline and fiber-forming and have a sufficiently high melting point. Structure has been shown to vitally affect melting point. It is known that hydrocarbon side chains reduce crystallinity. They probably act by increasing the separation of the chains and, particularly when unsymmetrically placed, by introducing linear and lateral disorder.

A particularly interesting demonstration of the relationship between fibers and rubber is furnished by a progressive reduction in the interchain forces responsible for fiber properties in nylon. This may be accomplished by methylation or methoxymethylation of the hydrogen bonding amide grouping. In these nylons, the hydrogens of the amide groups are partially substituted by alkyl groups. The bulky side groups prevent crystallization of the chains, yet the portion of unsubstituted amide groups remaining serve as links between the chains. The melting point falls rapidly with increasing substitution, accompanied by a reduction in modulus. There is a steady transition through the rubber-like state until finally, with complete substitution, the stage is reached where the polymer is a viscous liquid. This principle has been used in the production of experimental elastic nylons.

It is now evident that melting point, spatial symmetry, crystallinity, orientability, chain interaction and chain stiffness are all major contributory factors determining whether the high polymer is a fiber, a rubber, or a plastic. All synthetic polymers can be placed on one of the following overlapping zones:

(1) The rubber-like zone in which the forces between the chains are weak and the chains themselves are flexible. If the chains are of sufficient length, the characteristic rubber-like state is achieved.

(2) The amorphous or glass-like zone, in which the chains are less flexible, or the intermolecular forces are stronger. In this zone occur many of the plastics of commerce.

(3) The crystalline or fiber-forming zone, in which the regularity of the chains permits crystallization to occur along portions of their length. In this zone are polymers with weak interchain forces, as in polyethylene, or with strong hydrogen bonds, as in the case of nylon.

Effect of Morphology

Morphology is an important variable in fiber synthesis. Some of the morphological factors involved are: the shape of the cross section; the nature of the surface of the filaments and the kind of the crimp in the filaments. For example, the filaments of nylon are essentially cylindrical, while "Orlon" acrylic fiber is dog-bone in shape; dynel is ribbon-like and "Acrilan" acrylic fiber is kidney-shaped. If we examine the surface of "Orlon" filaments under polarized light, we discern a rough surface, while nylon has a smooth surface. Surface differences modify the coefficient of friction, fiber to fiber and fiber to tension guides; and they also have a marked influence on the tactile qualities of fabrics.

The aesthetic properties of fabrics, especially bulking power, are greatly modified by crimp in the fiber. Permanent crimp has been built into man-made fibers. Let us examine the cross sections of regular rayon filament and a special rayon known as "Fiber E," which develops a permanent crimp when exposed to the swelling action of dilute caustic. The crimpable fiber is seen to have a skin that occupies a part of its periphery, whereas the skin occupies the entire periphery in regular rayon. Exposure to caustic imparts a permanent crimp to the "Fiber E" filaments. It suffices to say that the physical structure of the filaments is effective in extending the versatility of fabrics produced from fibers and has a profound effect on the processing in textile manufacturing.

Polyvinyl Fibers

Of the various chemical classes used for fiber syntheses. the polyvinyl derivatives have offered a vast field of research and more than half of the new fibers belong to this class.

The polyvinyl fibers are composed of products resulting from the polymerization of vinyl compounds corresponding to the general formula: $CH_2 = CH$, in which the radical

$$\begin{array}{c} | \\ R \end{array}$$

R corresponds to the following groupings; -H, -Cl, -OH, $-O-C_2H_3$, $-O-CO-CH_3$, $-CH_3$, CN, etc.

Therefore, the polyvinyl derivatives posses the general formula:

$$-CH_2-\underset{\displaystyle R}{\underset{|}{CH}}-CH_2-\underset{\displaystyle R}{\underset{|}{CH}}-CH_2-$$

The high polymers are produced by addition polymerization, which consists simply of the union of unsatu-

rated molecules with a redistribution of the valency bonds. The unsaturated molecules are reacted under the influence of heat and catalysts to form high molecular weight polymers. Compounds such as vinyl chloride, vinyl acetate, vinylidene chloride and vinyl cyanide (acrylonitrile) are all resin monomers. Usually, these compounds can be polymerized by themselves or copolymerized with each other.

Historically, "Vinyon" fiber (vinyl chloride-vinyl acetate) possessed some very serious limitations, particularly low softening point and excessive shrinkage at temperatures encountered in laundering and pressing. The copolymerization of acrylonitrile with vinyl chloride materially improved the heat softening and shrinkage conditions and resulted in the improved fibers "Vinyon" N and dynel, produced by Carbide and Chemicals Corporation. With the discovery by Carbide of vinyl chloride-acrylonitrile copolymers of relatively high acrylonitrile content, the polyvinyl fibers could, for the first time, be seriously considered for domestic and apparel uses.

The intractibility of polyacrylonitrile suggested that a fiber produced from it would have remarkable stability. The polymer decomposed during melting and there were no known solvents. Ultimately, Latham discovered dimethyl formamide as a solvent and it became possible to spin fibers from polyacrylonitrile by the conventional methods of wet or dry spinning.

The production of 100% polyacrylonitrile fibers by du Pont is an event of great historic significance, since "Orlon" acrylic fiber, composed wholly or in substantial part of acrylonitrile, possesses even greater thermal stability than previous polyvinyls, permitting it to be used as a universal wearing apparel fiber. . . .

Interchain Attraction

It is of interest to review the effect of variations in chain stiffness and intermolecular forces on the polyvinyls. These have very flexible chains, but there are so many points of attraction along the chain that the sum of the attractive forces is sufficient to give fiber properties, although the individual bonds are quite weak.

In the polyacrylonitrile fibers, the intermolecular forces form between the nitrile groups and an alpha methylene hydrogen on an adjacent chain. From a comparison of the melting points of monomeric compounds, it is believed that this is a relatively weak bond. The CN groups are attached to every other carbon atom in the chain, causing so many points of bonding that the interaction of the chains is considerable. The resulting sum of intermolecular forces is sufficient to yield a relatively intractable polymer.

Regardless of the method of spinning, polyacrylonitrile fibers are crystalline in nature. They are never amorphous. Perhaps because of this crystalline nature, the fibers cannot be cold drawn like nylon. It is always necessary to heat or to swell the fiber to bring about orientation.

It is pertinent that the polyvinyl fibers, in general, are highly resistant to chemical attack, presumably because of their highly organized structure.

One of the most spectacular properties of the polyacrylonitrile fibers is their excellent resistance to sunlight. "Orlon" has often been called "the outdoor fiber." A comparison of the outdoor durability of several fibers indicates that polyacrylonitrile fibers have substantially better light resistance than other commercial fibers. . . .

Distinctive Properties

Each fiber has some property or combination of properties which is unique. Each fiber should be used alone or in combination with other fibers where its unique characteristics give it the best opportunity to contribute to fabric performance.

As a class, the new synthetic fibers are characterized by high strength, low moisture absorption, chemical inertness, launderability and immunity to micro-biological attack. Nylon is outstanding for its excellent resistance to abrasion and high elastic recovery; the polyvinyls, "Vinyon" and saran, for their resistance to chemicals; the acrylic fibers for their bulkiness and adaptability for outerwear apparel. The fibers which are substantially 100% polyacrylonitrile are notable for their excellent resistance to sunlight; while fibers from copolymers of vinyl chloride and acrylonitrile are generally non-flammable. "Dacron" polyester fiber is characterized by its unusual resistance to and recovery from wrinkling.

The Future

The diversity of characteristics of the new fibers has greatly increased the latitude of the textile technologist, from the standpoint of designing fabrics that will possess functionality and aesthetic properties for specific uses. The wide versatility of fabrics resulting from these new fibers is certain to have a stimulating influence on the entire textile industry.

Textile research has revealed that fabrics possessing greater versatility of function and design may be obtained by blending the new synthetic fibers with rayon, acetate, wool and cotton and it has been demonstrated that the chemical fibers and the natural fibers are complementary to each other.

While on the one hand there will be more signposts to guide scientists in the search for new fibers, it will become increasingly difficult to find new fibers of outstanding merit.

The future of present synthetic fibers will be greatly dependent upon the skill and ingenuity of the textile industry in designing fabrics which will utilize their distinctive properties in the most skillful manner. Intensive research on new dyestuffs, new methods of dyeing, elimination of static electricity and pilling, and finally, the influence of different kinds of clothing on physiological reactions must be carried out to support this new industry, in which there is so much confidence and enthusiasm at the present time.

The total petroleum refining capacity in the Far East is 268,310 barrels a day.

Electric power output is steadily rising, and coal's share of total electric power generation is tending to increase.

For the Home Lab

Nitrogen

by Burton L. Hawk

➤ It may surprise the average man to know that the greatest part of the air he breathes is not oxygen—but nitrogen. We have grown so familiar with the oxygen-carbon dioxide cycle, that we are prone to forget nitrogen which actually comprises 78% of the atmosphere.

We think of nitrogen in the air as a "useless" substance simply because it is inert. Actually, it is extremely important. Its presence dilutes the oxygen and thus slows down the process of oxidation. Without it, burning would be too rapid—decay and rust would run rampant—life would probably be much shorter.

Then there is the nitrogen cycle to consider. A special type of "nitrogen-fixing" bacteria which is present under the roots of leguminous plants (clover, peas, alfalfa, etc.) converts the free nitrogen of the air into nitrogen compounds which the plants can use. Finally, when living things die, decomposition sets in and eventually free nitrogen is restored again to the atmosphere. Thus the cycle repeats itself again and again, as it has since the dim beginnings of life and probably will until the end of time. By this remarkable process of fixation and decomposition the ratio of nitrogen to oxygen remains constant.

Nitrogen can be obtained from the atmosphere, but it is a rather difficult and cumbersome process for the home laboratory. Commercially, the air is liquefied and the nitrogen separated by fractional distillation.

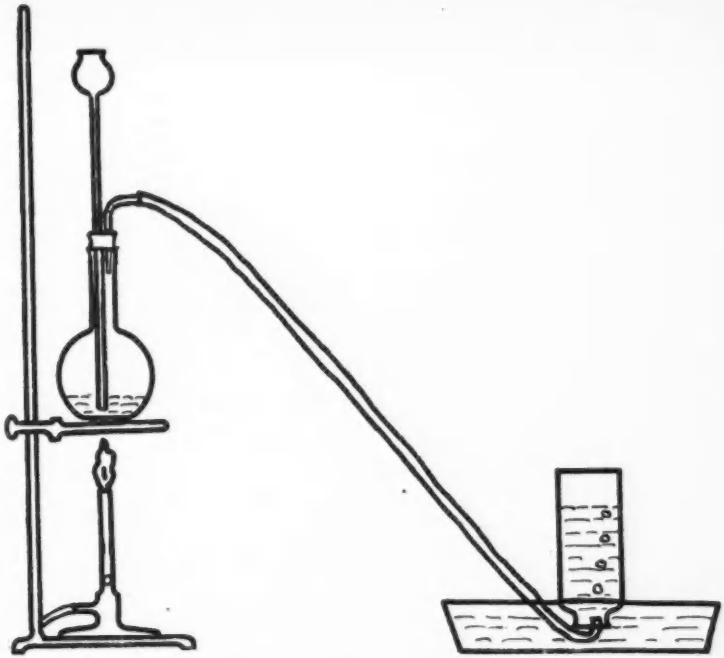
In the laboratory, nitrogen can be obtained conveniently from its compounds. Ammonium nitrite, when heated, decomposes into pure nitrogen and water:

$$NH_4NO_2 \rightarrow N_2 + 2H_2O$$

However, since ammonium nitrite is very unstable, there is some danger of explosion when it is heated. To avoid this danger, the ammonium nitrite is simultaneously prepared and decomposed in aqueous solution.

Mix together 5 grams of sodium nitrite with 4 grams of ammonium chloride in a large flask. Set up an apparatus designed to collect the gas over water, as shown in the accompanying diagram. Add about 30 cc. of water through the thistle tube and heat the flask gently. Allow the gas to bubble through the water in the trough a short time before collecting. When the bubbles form rapidly, place the rubber tube under the bottles in the trough and remove the flame from the flask. The nitrogen will displace the water in the inverted bottles. If the action in the flask should become too violent, pour in more cold water. If the bubbles form too slowly, apply heat again *gently*. Collect several bottles of the gas. Cover with a glass plate and remove the bottles from the trough.

Now that you have gone to all the trouble of preparing nitrogen, about



➤ COLLECTING *Nitrogen Over Water.*

the only thing you can do with it is throw it away. As we pointed out before, nitrogen is rather inert and reluctant to combine with other elements at ordinary temperatures. It, of course, does not support combustion. Insert a burning splinter of wood into a jar of nitrogen. It will be extinguished immediately.

However, magnesium will continue to burn in nitrogen to form the *nitride*, Mg_3N_2. Ignite a small strip of the metal and insert in a jar of nitrogen.

Carefully remove the white residue, grind to a powder and add a few drops of water. Do you recognize the odor of ammonia?

That's about all we can do with nitrogen in the laboratory. Nothing spectacular about it,—but a mighty important element!

Portable self-contained radioactivity survey instruments of the gamma type generally use a microammeter to indicate the radiation level.

Aims to Follow In Years Ahead

Tasks for Technology

From the Industrial Bulletin, A. D. Little, Inc.

➤ WE NEED prompt action to assure adequate raw materials for the future in order to surpass, or even to maintain, our present standard of living, according to the Paley report, "Resources for Freedom," submitted recently by the President's Materials Policy Commission. This report recommends specific steps to conserve our rapidly dwindling natural resources and to encourage expansion of the economy without endangering the materials situation. It also points out the areas which should receive technological attention, if future materials problems are to be minimized.

"The strongest and most versatile single resource in the fight against scarcities of materials is technology," states the report. Technology, however, has frequently increased the demand for scarce materials. Few of the tasks involved in stretching our resources are unsolved by science, but we must extend the academic solutions to the economically practical scale. In so doing, technology must follow six aims in the years ahead:

Techniques for Discovery

To foster new techniques for discovery. Conventional ways of finding ore bodies near the surface of the earth are approaching the limit of their usefulness. New techniques are now coming into use to detect traces of minerals on the surface as indications of deeper ore deposits. Geophysical exploration (use of sound waves caused by explosions to trace underground strata) has been successful in prospecting for oil and sulfur; this could be adapted to other mineral deposits. Geologic mapping, too, could be improved and extended to permit more accuracy in drilling.

Use New Materials

To bring into use materials which so far evade our efforts. Ease of conversion, rather than abundance, has been the traditional basis for choosing raw materials. Many relatively plentiful materials are not fully utilized because of difficulties or excessive expense in processing. Better understanding of the properties of some elements, such as silicon and zirconium, and cheaper production methods for others, such as oxygen and titanium, will greatly extend their use. Simple processes for extracting ores from low-grade or complex deposits will stretch supplies of metals that are becoming scarce in high-grade forms. For example, ores associated with "lateritic" rock formations weathered by the tropics are the world's greatest reserves of chromium and nickel, and are also rich sources of iron and cobalt. Known deposits contain perhaps 5 billion tons of iron, 100 million tons of chromic oxide, at least 50 million tons of

nickel, and several million tons of cobalt. If a method were devised to extract more than one metal in a single operation, these "laterites" would become important commercial sources. In the organic area, the chemistry of making useful products from lignin, a constituent of wood which is now largely wasted, is well understood. Widespread use of these processes is not now profitable, but if cheaper methods could be developed, the problems of waste utilization and stream pollution in this case might be solved simultaneously.

Recycling

To apply the principle of recycling more and more broadly. The chemical industry is cited as especially ingenious in utilizing the wastes of one process as the raw materials of another; the report urges greater inter-industry co-operation, it suggests a search for incentives and deterrents that will bring industrial practice more closely into line with public interests. Recovery of sulfuric acid from sulfur dioxide fumes in stack gases is an example of such "socially desirable" recycling. Even when the cost of recovery makes the equipment a questionable investment, social pressure against the noxious fumes may be a deciding factor. Improved methods for recovery of scrap metal are also desirable; at present two million tons of scrap iron and 12,000 tons of tin are wasted each year, chiefly because of a lack of satisfactory recycling.

Low Concentrations

To learn how to deal with low concentrations of useful materials. Methods worked out by the Atomic Energy Commission for the recovery of "rare earth" and other materials from concentrations previously thought impossible now offer promise for eventual industrial adaptation, if processing costs can be reduced. Ion exchange, already well known as a method of purifying water, is now under study as a possible means of extracting minerals from dilute solutions.

Renewable Resources

To develop and use more economically the resources that nature can renew. Conservation of soil and water reserves and the extension of improved agricultural methods offer many possibilities for speeding up the production of renewable resources, such as trees, livestock, and food. Energy resources are also being depleted at an unjustifiable rate, according to the report; except for hydroelectric power, all the heat and energy now used for space heating, industrial machinery, and transportation comes from irreplaceable fossil fuels. Direct use of solar energy would be a great step toward solving the energy problem.

Use Abundant Materials

To lessen or eliminate the need for a scarce material by substituting a more abundant one. Substitution of a more abundant, or better, or cheaper material for a traditional one is only beginning, especially in the field of metals. Frequently, such substitution awaits a technological advance; for example, aluminum could not replace copper in transmission lines until aluminum resistant to corrosion when under stress was developed. Direct substitution is not always necessary, however; use of microwave trans-

mission of telephone messages has already released large quantities of metal wire. Plastics and glass fibers, of course, are constantly finding new applications where they may substitute for metals. Even so, substitution may often pose new supply problems, and secondary substitutes must be developed in order that new shortages do not occur.

The tasks set for technology in its struggle to extend the "Resources for Freedom" will be coupled with other tasks of equal scope: to find the necessary manpower, to learn to adapt scientific advances more rapidly to meet public need, and to raise the required capital. No matter what the task, the Paley report shows that the incentive is great.

Synthesis of Firefly Light Soon

➤ HOPE for being able to manufacture artificially the stuff which makes fireflies glow is seen by Dr. E. Newton Harvey, professor of physiology, Princeton, in intensive studies now under way at that university.

Princeton's Dr. H. S. Mason has recently found two types of luciferin in a shelled creature called Cypridina. Luciferin is a chemical compound which, when acted upon by the enzyme, luciferase, produces the emission of light which is characteristic of about 40 different animal groups and two plant groups.

These two types of luciferin are being intensely studied in the Princeton biological laboratories. The hope is that this study will lead to a knowledge of luciferin and finally to its synthesis.

Dr. Harvey said, in the annual Sigma Xi lecture before the American Association for the Advancement of Science, that there appears to be no definite evolutionary trend toward light-producing animals. Sometimes, he said, in higher animals, the photogenic cells which produce the light are surrounded by a reflector, a pigment screen and a lens, forming a complicated lantern. In other light-giving creatures, bacteria supply the source of light. Sometimes the host animal has developed an opaque screen which, like a shutter, controls the source of light.

Light of all colors has been seen in the various groups of light-emitting animals — red, yellow, green and blue. Some animals have developed lights of two or three different colors. The "railroad worm" of South America, has a red light and two rows of yellow lights, which make it look like a train.

The lights are used, in some cases, to attract the opposite sex for purposes of mating, in other cases as a lure in obtaining food, or to scare off bigger fish in search of food for themselves.

Silica particles less than a millionth inch in diameter are promising thickeners for greases to make them stand up under heat such as may interfere with the lubrication of bearings in heavy service.

Lost Enzyme Seen As Cancer Cause

New Light on Cancer Mechanisms

➤ Loss of an enzyme chemical from some body cells may be the cause of cancer.

Studies supporting this theory of the cause of cancer were reported by Dr. James A. Miller of the University of Wisconsin at the recent meeting of the American Association for the Advancement of Science.

Cancer researchers have for years thought that the reason cancer cells multiply without the restrictions of normal cells is that some chemicals in the cells or some genes are changed when the cells become cancerous.

Dr. Miller's theory is that a chemical is somehow lost entirely from the cell. This chemical, perhaps an enzyme, according to this theory is the growth self-governor of the cell.

Support for the theory comes from studies of rats that get liver cancer when fed an azo dye. The dye, Dr. Miller said, combines with and possibly destroys the chemical effectiveness of certain proteins necessary for control of growth but not for life.

If this continues, cell generations might arise, he said, which lack entirely one or more growth control chemicals. These cells could respond to continued nourishment on'y by continuing to grow and would thus be tumor or cancer cells.

Spread of Cancer

➤ The spread of cancer from other parts of the body to the liver can be traced by a promising new method developed by three University of California at Los Angeles scientists and reported at the Radiological Society of North America meeting in Cincinnati.

The new technique was developed at the Los Angeles Veterans Administration Center by Dr. Lloyd A. Stirrett and Dr. Eric T. Yuhl of the surgical staff and Dr. Raymond Libby, consultant physicist.

The method involves the use of small, intravenous injections of human serum albumin combined with radioactive iodine. For some reason, cancerous tissue takes up more of the radioactive iodine than normal tissue.

A scintillation counter, an instrument much more sensitive to the gamma radiation from radioactive iodine than a Geiger counter, is used to detect the malignant area. The scintillation counter was developed at the U.C.L.A. Atomic Energy Project. It has been used with considerable success by Dr. Yuhl and Dr. Stirrett for the diagnosis of brain tumors.

To date, the test has been applied to more than 150 patients with proved cancers and has been 95% accurate in diagnosing whether or not the cancer has spread to the liver. Occasional false positives occur in patients with diseases which produce accumulations of fluid within the abdomen.

The test takes only 20 minutes to perform, is harmless and there is no

discomfort whatsoever to the patient. It has been used extensively in the surgical department of the Veterans Administration Hospital in the study of patients before and after cancer surgery.

The doctors emphasized that this procedure is not a test for cancer in general, but only for cancer of the liver.

As for the future possibilities of the technique being used to locate cancer anywhere within the body, the researchers are uncertain.

Radioiodine Dangerous

➤ DOCTORS were warned that it may be dangerous to give radioactive iodine to mothers while they are breast feeding their babies.

The warning came in a report by Drs. Carl E. Nurnberger and Alys Lipscomb of the University of Tennessee College of Medicine, Memphis, to the *Journal* of the American Medical Association.

Enough of the radioactive chemical gets into the mother's milk to allow a sizable amount to be taken up by the baby's thyroid gland. If the radioactive iodine is being given the mother for treatment of thyroid trouble, the baby might get so much that its thyroid gland would become "seriously" underactive or might even stop functioning completely.

If the chemical is given in tracer doses for diagnosis of possible thyroid trouble in the mother, enough of it would be diverted via the milk to the baby so that the result of the test might be inaccurate. In one of the cases reported by the Memphis doctors, the baby's thyroid gland had taken up five percent of the diagnostic tracer dose of radioactive iodine given the mother 24 hours previously, while the mother's gland had taken up 34%. Tests of the mother's milk showed some of the radioactive iodine present in it.

Male Hormone Change

➤ BETTER RESULTS from male hormone treatment of cancer are expected as a result of studies by Dr. Henry M. Lemon and associates of Boston University School of Medicine.

A method has been developed by these scientists for determining the chemical action between cancer cells and male sex hormones, the American Cancer Society announced. The method involves the use of chromatography.

Normal tissue, the scientists find, changes the male hormone into other chemical compounds at a fairly uniform rate. Cancerous tissue changes the hormone at a rate that varies widely and has no uniformity.

Dr. Lemon reported the findings at a meeting of the American Federation for Clinical Research.

Ultraviolet Spots Cancer

➤ A SPECIAL ultraviolet light, called the Wood light, will show a difference between highly malignant skin cancers and low or non-malignant skin sores, Dr. Francesco Ronchese of Boston University Medical Schoo! stated at the Chicago meeting of the American Academy of Dermatology and Syphilology.

The advanced cancers give a vivid orange red fluorescence while noncancers or low-grade cancers do not fluoresce at all under the Wood light, Dr. Ronchese said.

He showed what is believed to be the first satisfactory photographic record of this ever obtained on living human subjects.

Scientists Fight Disease In Man, Beast and Plant

Chemicals Save Costly Losses

➤ FIVE MILLION deaths and 100,000,000 serious illnesses have been prevented by DDT since it came into common use ten years ago, Dr. Edward F. Knipling, president of the American Association of Economic Entomologists, told members of his society in Philadelphia.

Malaria and typhus fever control account for the largest part of these encouraging figures, Dr. Knipling said, although other insect-borne diseases, like dysentery and typhoid, have been greatly cut by DDT, too.

On the other hand, there are no recorded cases of deaths or serious illnesses caused by DDT from its use as an insecticide.

The number of poisonings from common household chemicals like aspirin and ammonia, Dr. Knipling said, reduces to insignificance the few cases of intentional or accidental poisoning by direct consumption of DDT.

Fight Poultry Disease

➤ WITH THE HOPE of helping to prevent air sac disease of poultry, which may kill up to 50% of affected chickens and turkeys, the Food and Drug Administration issued a new regulation permitting addition of para-aminobenzoic acid to poultry feed.

This chemical, sometimes classed with the B vitamins, will not, FDA is satisfied, cause any harm to people eating the chickens and turkeys that get it in their feed. And if it can stop air sac disease, it may mean more chickens and turkeys for people to eat. It may be added directly to feeds or with the antibiotic formula used to promote growth.

Air sac disease is a chronic ailment which has become more prevalent and more important economically within the past two years, although poultrymen have known it for much longer. The reason for this increase is not known. Scientists are not agreed on the cause of the disease, though a germ somewhere between a bacterium and a virus in size is considered at least one cause.

Besides killing birds, this disease is a debilitating one causing extensive loss of flesh and drop in egg production. In broilers it may prolong the time they must be fed to marketable size from the usual 10 or 11 weeks to 15 or 16 weeks.

Seek Key to Virus Puzzle

➤ WHY TOBACCO mosaic viruses act one way in a small, tender leaf and differently in a larger, older leaf is being investigated at the University of California at Los Angeles for clues to how viruses work, by Drs. Morris Cohen, Albert Siegel and Samuel G. Wildman.

Their study has revealed that if a small, young tobacco leaf is inoculated with two strains of virus, the strains become competitors. In the ensuing "battle" one strain tends to pro-

pagate much more rapidly and to predominate throughout the plant.

In a mature tobacco leaf, something else happens. When the two strains are introduced into the large leaf, they coexist peacefully. Both propagate equally well.

Why this should be so may furnish much insight into the virus problem, the U.C.L.A. researchers say.

Coffee Disease Foiled

➤ OUR BREAKFAST cup of coffee and the one and a third billion dollar yearly coffee industry in Latin America has been saved.

Probably few of the Americans who drink 115 billion cups of coffee a year had any idea that their favorite brew was in danger of extinction. But a rust disease called "a killer" by experts threatened the coffee plants of the species *Arabica* grown in Latin America. This rust disease, *Hemileia*, virtually wiped out the coffee industry of the eastern hemisphere in the late 19th and early 20th centuries.

A coffee hybrid resistant to this rust disease has been discovered in South India by Drs. Frederick L. Wellman and William H. Cowgill of the U. S. Department of Agriculture. Seeds of this hybrid have been obtained for propagation quarantine in the USDA plant introduction garden at Glenn Dale, Md. If they can be grown successfully in this hemisphere, coffee will have been saved, at least from the present threat.

Mothproofing in Rinse

➤ THE U. S. DEPARTMENT of Agriculture has just developed a new insecticide that lets the housewife mothproof her washable woolens at the same time she runs them through the washing machine.

Called EQ-53, the solution contains DDT and other chemicals which knock out the wool-hungry larvae of clothes moths and carpet beetles. Two teaspoons of the solution added to the wash water in average-sized washing machines will protect a pound of woolen blankets and sweaters for more than a year.

The new insecticide should be commercially available by spring and should not cost much.

New Dry Ore Refining

➤ A DRY electrical process for obtaining potash and phosphate concentrates from the ores in which they are found, announced at Carlsbad, New Mexico, by Louis Ware, International Minerals & Chemical Corporation, is said to be more economical than the methods generally employed, which require the use of chemical reagents or water.

This new method of refining ore will be known as the LeBaron-Lawver dry beneficiation process, taking the name from the two staff members of the corporation responsible for its development. In the process the ore is ground, dried and given a simple and inexpensive treatment. The fine ore is then passed between electrodes which separate it into the various minerals it may contain. A large potash-producing unit which will utilize the new process is now being designed.

New Fertilizer Made, Plant Tonics Described

Chemists Offer Help in Gardening

➤ FERTILIZERS will be made by new processes for economical production of more concentrated plant food.

Production of ammoniated phosphorus fertilizer in an alkaline solution is a novel process described to the American Chemical Society at its recent meeting, by Dr. Louis E. Andres of Potasse & Engrais Chimiques, Paris, France.

Use of phosphoric acid to replace all or part of the more usual sulfuric acid, now in short supply, and at the same time to aid in by-product uranium recovery was described by L. D. Yates and F. T. Nielsson of the Tennessee Valley Authority and E. J. Fox and R. M. Magness of the U. S. Department of Agriculture.

Increased amounts of ammonia are incorporated into phosphate fertilizer without loss of material in insoluble form in the French alkaline process of Dr. Andres. This can be done by addition of ammonium citrate if small amounts of magnesium salts are put into the mix.

The Atomic Energy Commission's request that more phosphoric acid be manufactured to aid in uranium recovery as a by-product from fertilizer manufacture has stimulated experiments by the U. S. Department of Agriculture and TVA on improved uses of phosphate rock. Phosphoric acid is used to make higher grades of superphosphate fertilizer, for which increasing demand is noted.

Other developments in fertilizer manufacture are partial replacement of sulfuric by nitric acid in making superphosphate, described by David McKnight, J. F. Anderson, Jr., M. M. Striplin, Jr., and T. P. Hignett of the Tennessee Valley Authority, Wilson Dam, Ala.

Fertilizer for areas where magnesium is needed in the soil, but sufficient nitrogen is available, are produced by melting rock phosphates with magnesium and potassium sulfates in a new process described by G. L. Bridger and D. R. Boylan of Iowa State College, Ames, Iowa.

Improvement of mixed fertilizers by study of the results of adding ammonia in various amounts was reported by F. L. Turbett and J. G. MacArthur of the Spencer Chemical Co., Pittsburg, Kans.

Grow Seedless Tomatoes

➤ SEEDLESS tomatoes have been grown in weedless gardens, using a chemically changed form of the weed killer, 2,4-D, Department of Agriculture chemists have reported.

The modified weed-killing compound also causes the fruit to grow larger and the quality is excellent, Dr. G. E. Hilbert, chief of the Department of Agriculture's Bureau of Agricultural and Industrial Chemistry told Science Service.

Ordinary 2,4-D harms tomato plants, sometimes even killing them. By combining the 2,4-D with certain

amino acids, those known as l-amino acids, the chemists made the compounds that helped the tomato plants. They tested the weed killer combined with the l-form of 12 of the 22 or 23 known amino acids, and got the beneficial results each time.

All tests, however, Dr. Hilbert warned, have been made under controlled greenhouse conditions, and field tests are necessary before the results can be applied commercially.

Drs. J. W. Wood, T. D. Fontaine, chemists, and Drs. J. W. Mitchell and Paul Marth, plant physiologists, all of the Bureau, conducted the studies with the modified 2,4-D.

Wonder Drug Spurts Growth

➤ JUST A soupçon of the antibiotic terramycin in the water fed to corn seedlings gives them a spurt of growth.

Usually used to cure and prevent diseases, the so-called wonder drug can also stimulate plant growth, Dr. Louis G. Nickell, head of the phytochemistry laboratory of Chas. Pfizer & Co., Brooklyn, N. Y., told the American Institute of Biological Sciences meeting at Ithaca, N. Y. Antibiotics have also been used in feed for poultry and hogs to stimulate their growth. Seemingly both effects are obtained by holding down the growth of undesirable microorganisms.

Five parts of terramycin per million of water used in watering sweet corn seeds for only four days almost doubled the weight of the plants above ground at four weeks.

After more experiments this may be applied to practical farming.

Branches Take Nourishment

➤ THE STEMS and branches of trees can take up nourishment if the fertilizing material is sprayed upon them. So can the leaves.

This was shown in tests at Michigan State College's Department of Horticulture, East Lansing, Mich. with radioactive sources of potassium, phosphorus and carbon.

Foliage feeding which is now being practiced to some extent must therefore take into account the chemicals absorbed by the trunk, branches and shoots as well as the leaves.

But even the bark feeding is not new: among the first field applications of commercial nitrogenous fertilizers to fruit trees were sprays to dormant trees.

A team of Michigan State scientists, H. B. Tukey, R. L. Ticknor, O. N. Hinsvark and S. H. Wittwer, report their experiments with radio-carbon-containing urea to the journal, *Science*.

Rare Mineral Nasonite

➤ A DEPOSIT of the extremely rare mineral nasonite, one part of it yellow and the other a pale bluish-green, has been found for the first time in the West in a commercial quarry at Crestmore near Riverside, Calif. The only other known occurrence of nasonite is in zinc deposits at Franklin, N.J.

The discovery was made by Dr. Joseph Murdoch, professor of geology at the University of California at Los Angeles. Nasonite, he said, is a form of calcium lead silicate and is derived from earlier galena. The variation in color is due to accessory elements, vanadium giving yellow, copper blue.

Deodorant Claims Furnish Chemists "Good Clean Fun"

Chemist Debunks "Chlorophyll"

➤ A "DOUGHNUT that exists for the hole"—that is the chemist's description of chlorophyll, green coloring of plants, which is being put into everything from toothpaste to dog foods because of its supposed deodorizing power.

The supposed deodorizing effect of chlorophyll as well as some of the other properties claimed for it were debunked by Prof. Alsoph H. Corwin, head of the department of chemistry in the Johns Hopkins University, at the New York meeting of the American Chemical Society.

The hole in the chlorophyll "doughnut" or ring structure, however, is fact, not bunk. It exists, Prof. Corwin said, for the purpose of holding metallic elements, which are thus made available for certain types of chemical reactions. In the case of chlorophyll, the metallic material is magnesium. In hemin, the blood's red pigment, the metallic material is iron.

Chlorophyll derivatives taken by mouth to deodorize perspiration and other odors probably do not get into the blood stream in sufficient quantity to deodorize, and, if they did, they would be "extremely dangerous" in making their users sensitive to light, Prof. Corwin declared.

As a deodorant for foul-smelling wounds, Prof. Corwin said that the experiments necessary to demonstrate that solutions of chlorophyll are in fact superior to those of common salt have not been performed.

Space deodorant devices which contain chlorophyll derivatives appear to freshen the air for two reasons, Prof. Corwin said. They always contain a pleasant odor which can mask the less pleasant odors; and most such preparations also contain formaldehyde. The common action of this substance, he pointed out, is so to paralyze the sense of smell that odors can no longer be detected.

Chlorophyll is probably the most important pigment in the world, since it is ultimately responsible for the fixation of the energy of the sun by plants. This process, called photosynthesis, is the final source of all our food and a major fraction of our power.

Aside from this, chlorophyll has esthetic value in coloring the vistas visible from hills and mountains. It furnishes chemists, physiologists and other scientists with a lot of good clean fun. For other purposes, Prof. Corwin stated, we are not certain that it has any value.

A coal-mine explosion travels at 5,000 miles an hour, or about six times the speed of a jet plane and about twice as fast as a rifle bullet.

Most acid soils need a substantial application of lime, roughly equivalent to one ton of limestone, every 4 or 5 years.

Chemotherapeutants Essential to Efficient Production of Crops

New Agricultural Fungicides

A paper presented by Donald M. Yoder, senior fellow in biological research, Carbide and Carbon Chemicals Co. and Boyce Thompson Institute for Plant Research, at the symposium on contributions of chemistry to agriculture at the St. Louis meeting of the American Association for the Advancement of Science.

➤TREMENDOUS progress has been made in the last decade in controlling plant diseases with chemicals. It is part and parcel to the progress being made in insect control and chemical weed control. It stems from the rather recent entry of large segments of the chemical industry into the field of agricultural chemicals. There seem to me to be three important factors which have made this progress possible. Each factor represents the cooperative efforts of several agencies both public and private.

The first factor is the development of reliable methods for evaluating chemicals for fungicidal effectiveness. Many such contributions have come from the laboratories of Boyce Thompson Institute, others from experiment stations and the United States Department of Agriculture.

The second factor is the systematic search for new and more effective fungicides which is now conducted largely by the chemical industry.

The third factor is the education of the farmer and orchardist in the proper use of the fungicide to give maximum benefits. This program has been carried on tirelessly by extension workers and research staffs of the federal and state experiment stations.

I will have to use terms and concepts with which many of you are unfamiliar so let me start by making sure we all understand what a fungus is and why we need fungicides. Fungi are plants, mostly of microscopic size, which lack chlorophyll and consequently cannot synthesize their food from carbon dioxide, water and minerals as do the green plants. Fungi get their food ready-made from other organisms. We are concerned here with those fungi which obtain their food from living plants, that is to say, fungi which are parasites on plants. Plant diseases are the manifestation of the food-getting processes of the fungi. Bacteria and viruses also cause diseases of plants. Each disease is caused by a particular fungus, bacterium, or virus and is recognized by the symptoms shown by the plant. Fungi can produce millions of spores or seeds in a very short time and each spore is capable of causing disease if the environment is favorable.

It has been conservatively estimated that there are 7000 fungi, 175 bacteria and 163 viruses — all presumably distinct entities — which are known to attack plants. Some of you, not having reflected upon the matter, may have considered the poor showing of your early spring peas or the shoddy, late summer appearance of your lilacs

or roses to be due to some indefinite entity associated with unusual weather or adverse growing conditions. If you have been guilty of this type of thinking you will no doubt be shocked to learn that some crops are subject to almost as many diseases as we humans. For example, corn is subject to 112 infectious diseases, wheat 77, and apples 200. Even considering that plants do not have an intellect to multiply their troubles as have you and I, they are subject to a pretty high incidence of calamity.

Fungi and the other disease-inciting organisms can attack the plant's roots, stem, leaves, blossoms, or fruit. They can destroy seed in the soil before a new plant is produced or they can develop apace with the seedling, growing in intimate association with the plant tissue, finally entering the seed and providing for their own propagation in the perverted seed of their host. From a practical point of view all of these activities can result in lower yield and less profit to the grower of the crop attacked.

Chemical Fungicides

Fungicides are chemicals which kill fungi or prevent their development. Most commonly they are sprayed onto the aerial parts of the plant forming a toxic coating which will kill the fungus spores falling onto these surfaces and thus prevent disease. These are protective fungicides.

Some chemicals by virtue of their volatility or solubility penetrate the outer layers of the leaf or fruit and can therefore kill a fungus which has penetrated these tissues. These are called eradicant fungicides.

Seeds of many plants are susceptible to attack by soil fungi especially during the early stages of their germination and must be protected with a coating of chemical. Chemicals used for this purpose are called seed protectants.

Fungicides may be applied directly to the soil to control certain soil-borne diseases affecting crop plants. These are soil fungicides.

Absorbed by Plants

Chemicals may be absorbed by the roots of plants after soil application or by the leaves after spraying and either due to a subsequent effect upon a fungus or because of some change they bring about in the plant — allow a plant to remain healthy which would otherwise have become diseased. These chemicals are called systemic fungicides or chemotherapeutants and they are the newest weapon in the growing arsenal of disease-control agents. I will have more to say about chemotherapeutants later.

Each of these uses for fungicides has its own particular set of requirements which an effective fungicide must fulfill. For example, when protective fungicides are applied as sprays, they must be soluble in water, or emulsifiable in water, or they must be finely ground, wettable and dispersible in water. At the same time the preparations must not be so surface active that they foam excessively under agitation or are too easily washed off the leaf by dew or rain. Fungicides intended for application as dusts must be very finely ground and free flowing. All protective fungicides must be chemically stable so that they are not affected by heat, light, moisture, or by admixture with numerous other pest control chemicals. They must not

be hazardous for the applicator nor create a residue problem, nor cause unnatural colors, odors, or flavors in the finished product.

The responsibility for better fungicides is shared by the chemical industry and the experiment station. Chemical companies want to sell products and confidence — confidence in future agricultural chemicals which their research programs are sure to produce. The experiment stations want to see that the farmer gets the full benefits of the proper use of these fungicides. Industry has taken over the job of finding, producing, and marketing new fungicides. The experiment stations have the task of deciding which of the new materials offered for sale are most effective for the particular needs of the farmers in the area they serve.

Finding New Chemicals

You might be interested in knowing in a general way how industry carries out its part of the bargain — the finding of new fungicidal chemicals. The procedure I will discuss is that used by our group but it is representative of what other laboratories are doing.

The first step is getting the chemicals for biological evaluation. Our chemicals come from two main sources.

(1) Chemicals available to the company as basic products, as by-products or those synthesized for chemical research programs.

(2) Chemicals synthesized specifically for biological evaluation.

Chemicals in the first group make up a high proportion of our chemicals and they serve the important function of giving the biologists a chance to evaluate a wide variety of chemical structures some of which may show enough promise to warrant synthesis of analogues and derivatives specifically for biological evaluation. Of course, the higher the proportion of chemicals synthesized specifically for biological evaluation, the greater the chances of success.

Simple Tests

The tests performed on these raw chemicals must be short and simple so that very large numbers of compounds may be examined. Once active compounds are discovered then the tests performed may be more elaborate and time-consuming. We first test our candidate chemicals in the simplest sort of a test which involves chemical, fungus, and water. Water is the total environment so the test is precise but not very significant. We think the results of this spore germination test indicate the amount of inherent fungitoxicity present in the chemical.

The next test involves chemical, fungus, plant and environment. Chemicals are formulated and sprayed onto greenhouse grown plants. Fungus spores are then sprayed on the treated plants which are then placed in a controlled environment optimum for the development of the disease. With so many variables this test is not as precise as the former but much more significant since it simulates many of the conditions of actual use of a fungicide.

Dosage Response

In both these tests quantitative data are obtained and the relationship between applied concentration and biological response can be expressed in

the form of a dosage-response curve. In its most useful form the dosage-response curve is plotted on logarithmic probability paper. The significant facts about the dosage response curve for any particular chemical can be expressed as the dosage for 50% response (ED 50) or 95% response (ED 95) and the slope of the curve. The lower the ED 50 and the lower the slope value the more effective the chemical.

Application Test

The final test is the actual application of the candidate fungicide to a susceptible field crop preferably using standard spray equipment and under conditions of severe disease. The inclusion of appropriate standard fungicides for comparison is important in interpreting the results of the test.

By intelligent use of dosage-response information and by careful comparisons with existing fungicides, the relative fungicidal effectiveness of a new chemical can be determined. Its possible value as a commercial fungicide is dependent upon its mammalian toxicity and cost as well as its fungicidal effectiveness, physical properties, chemical stability, and effect on plants.

The first of the modern organic fungicides was tetrachloro-*p*-benzoquinone. This chemical, which was first marketed in 1940, demonstrated the remarkable advantages of organic compounds over the inorganic chemicals previously used. Thirty cents worth of this chemical would treat enough spinach seed to plant an acre of crop but the increase in gross return as a direct result of this thirty cents spent for fungicide was as high as $300 per acre — a thousand fold return on investment! Spectacular results such as these called attention to the virgin field of organic chemistry as a source of effective fungicides.

It seemed reasonable that the innumerable possibilities of variation in the structure of organic molecules would make possible fungicides which were more effective because they were more specific both with regard to toxic effect on the fungus and nontoxic effect on crops. Organic fungicides would probably be more costly than inorganic fungicides but their greater effectiveness would offset their higher cost. This line of reasoning has proved to be essentially correct.

Quinones as Fungicides

The chemicals that followed tetrachloro-*p*-benzoquinone into use as fungicides can be divided according to structure into quinones, dithiocarbamates, heterocyclic nitrogen compounds, and phenolic compounds.

Two quinones have found use as fungicides: Tetrachloro-*p*-benzoquinone is an effective seed treatment but is light sensitive and is therefore not effective as a foliage protectant. 2,3-Dichloro-1,4-naphthoquinone is used both as a seed protectant and as a foliage fungicide. Other quinones are known to be fungicidal but are not being sold at present, for example, 2-methyl-1,4-naphthoquinone, 5-hydroxy-1,4-naphthoquinone, and acenaphthene quinone.

The fungicidal activity of the quinones has been ascribed to the fact that they can readily undergo reversible reduction to the hydroquinone state and may thus upset the sensitive redox systems of fungi. The fact that many quinones occur naturally in

plants suggests that the fungicidal quinones by virtue of structural similarity to the naturally occurring quinones may act as antimetabolites.

In point of time the second group of organic fungicides was the dithiocarbamate group. The marketing of the first members of this group followed soon after the introduction of tetrachloro-*p*-benzoquinone. As a matter of fact, however, the early experimental work on the dithiocarbamates dates back to the early days of the depression when the climate for fungicide research and the market for fungicides was equally discouraging. Today, however, the dithiocarbamates hold the largest market of any of the organic fungicides—a market estimated to be 8 million pounds per year. Of proven value are the ferric, zinc, and sodium salts of dimethyldithio-carbamic acid; the zinc, manganese and disodium salts of ethylene bisdithiocarbamic acid and tetramethylthiuram disulfide. More recently a mixture of 2-mercaptobenzothiazole and sodium dimethyldithiocarbamate has been marketed.

Rubber Vulcanizers

Some of these compounds were first available for use as vulcanization accelerators in the rubber industry. With the discovery of their biological properties other analogues and derivatives were synthesized. It was found that the dimethyldithiocarbamates were more effective than either the diethyl- or dibutyl- analogues. The iron, lead and zinc salts were the most promising since they showed high fungitoxicity and low phytotoxicity. Both the ferric and zinc salts are now being used to control a large number of plant diseases although the zinc salt cannot be used on certain zinc-sensitive crops such as apples. Tetramethylthiuram disulfide has largely displaced the organic mercury compounds as a seed treatment for corn and is now the largest selling seed protectant. This chemical is also being used as a turf and a soil fungicide.

The derivatives of ethylenebisdithiocarbamic acid were found to be generally more active than the dimethyldithiocarbamates although not effective against the exact same group of diseases. In the synthesis program it was found that the compound made from *n*-propylenediamine and isopropylenediamine were not as active as the one made from ethylenediamine. In both series the compound having the smallest proportion of carbon and hydrogen relative to the dithiocarbamic acid moiety was the most fungicidal. The disodium, zinc, and manganese salts are now used extensively for the control of foliage diseases on a variety of crops including the biggest markets — potatoes, apples, and tomatoes.

Action Obscure

The mechanism of action of the dithiocarbamates is still obscure although it has been suggested that the ethylenebisdithiocarbamates break down in a biological system to give ethylenediisothiocyanate which is highly toxic both in solution and as a vapor. It has been shown that the dithiocarbamates readily give off carbon disulfide especially when in contact with living tissue but this compound is not sufficiently toxic to fungi to account for the toxicity of these fungicides.

The compounds grouped together here as heterocyclic nitrogen compounds have little in common except their general structure and the fact that they are of more recent introduction. 2-Heptodecylimidazoline was first tested in 1941 and first marketed in its present form as the acetate dissolved in isopropanol, in 1948. As such it is an easily handled liquid which has given excellent control of certain fruit tree diseases. This fungicide also has mild miticidal properties. During the early studies on imidazolines it was found that an alkyl side chain was essential for fungicidal effect and that activity increased with increasing chain length through the 17 carbon lengths. This compound was also found to be the safest on foliage.

Labeled Chemical Research

Investigations on the mechanism of action of 2-heptadecylimidazoline using labeled chemical have shown that it is very quickly taken out of solution by the spores. Under certain circumstances up to 90% of the external chemical is removed from solution in less than one minute. Measurements have been made which show that the concentration of chemical built up within the spore may reach 10,000 times that of the external solution to which it was exposed. In a particular experiment the spores absorbed this chemical to the extent of 2% of their original weight. It is not difficult to believe that when such a concentration of a surface-active molecule is attained within a spore its life processes are completely disrupted.

A chemical quite similar structurally to 2-heptadecylimidazoline is 2-heptadecyl-4,4,6-trimethyltetrahydropyrimidine. This compound is being tested on fruit and vegetables but its true usefulness has not yet been determined.

A second new fungicide classed as a heterocyclic nitrogen compound is N-trichloromethylthiotetrahydrophthalimide. This compound appears to be effective against a wide range of diseases of fruits, vegetables, and ornamentals although it is not effective in dosages as low as is the case with some of the fungicides previously mentioned. Its wide spectrum of activity is unusual among the organic fungicides which, in general, have tended to be more specific in their action than the inorganic fungicides. The most active part of the molecule appears to be the trichloromethylthio-group and the addition of this group to other amides and to dithio acids has enhanced their fungitoxicity.

A compound still in the early stages of commercialization is 3,5-dimethyltetrahydro-1,3,5,2-H-thiadiazine-2-thione. This chemical has the remarkable property of being effective both as a fungicide and as a nematocide.

Controls Diseases

An entirely new chemical is 2,4-dichloro-6-(*o*-chloroanilino)-*s*-triazine. Its potential uses are not clearly shown by its testing so far but it has been used successfully to control vegetable and fruit diseases.

8-Quinolinol and 8-quinolinol benzoate have been successfully used on a small scale as systemic fungicides. Copper 8-quinolinolate is a very effective fungicide but its high cost imposes a serious limitation of its extensive use as an agricultural chemi-

cal. It is being used in quantity as a fabric protectant.

The phenolic fungicides have found less application as agricultural fungicides because they have generally been phytotoxic. 2,4,5-Trichlorophenol and its zinc salt and its ester with acetic acid are used as seed protectants for cotton and peanuts. Pentachlorophenol and dinitro-*o*-*sec*-butylphenol are used as dormant spray fungicides. *o*-Phenylphenol is recommended for use as a dip for fruit to prevent fungus damage in storage and transit. 3,5-Dimethyl-4-chlorophenoxyethanol has been shown to be a chemotherapeutant for certain wilt diseases and at least one virus disease.

Conclusions

The use of fungicides is now recognized as an essential adjunct to the efficient production of many crops. Without fungicides a billion dollars worth of crops such as apples, potatoes, grapes and cherries could not be grown. The new fungicides are superior to the older ones for many uses and control diseases which the latter did not control. Many are less injurious to plants and less hazardous or disagreeable for the user. Together they share an $8,000,000 market.

In spite of the most intelligent use of these fungicides there is still a billion and a half dollars worth of agricultural produce destroyed each year by fungi. Unsolved are the many problems of preventing fungus damage to fresh produce in storage or on its way to market. This is a dual problem of finding a chemical which has no residue hazard on the food product in so far as toxicity to humans is concerned but which still has adequate fungitoxicity.

Unsolved also is the problem of controlling harmful soil fungi economically. These chemicals of proven value are expensive and difficult to use since for the most part they are highly volatile materials such as chloropicrin, dichloropropene, and methyl bromide. Frequently, soil fungi and nematodes are companion problems so that a chemical like 3,5-dimethyltetrahydro-1,3,5,2-H-thiadiazine-2-thione having both fungicidal and nematocidal properties, should fill a definite need.

Several of the most serious diseases of plants as yet uncontrolled, are caused by soil inhabiting fungi which enter the plant through its roots and grow progressively upward through the vascular system entirely inside the plant—so that the usual topical application of fungicides can not reach and destroy the fungus. For this type of disease, an entirely new kind of chemical is being sought—one that will be absorbed by the plant roots or leaves and be moved about in the plant so that adequate concentrations will be present in the circulating system of the plant to intercede against the fungus. At the same time the chemical must be noninjurious to the host. 8-Quinolinol and its ester with benzoic acid and 3,5-dimethyl-4-chlorophenoxyethanol are known to be effective in this manner. Chemicals of this type are called systemic fungicides or chemotherapeutants. The latter term is preferred because, strangely enough, some of the chemicals known to be effective do not have fungicidal properties in the usual sense.

The use of chemotherapeutants is not limited, in theory at least, to the control of internal fungus disease.

Viral and bacterial diseases are of similar nature. Furthermore there seems to be no good reason why, if the right chemicals can be found, that a prophylactic concentration of chemical cannot be maintained in the plant so that it is chemically immunized against disease. The search for chemotherapeutants is now in full swing and the products of this research can be expected to revolutionize our concepts of chemical disease control just as much as did the advent of organic fungicides a decade ago.

➢ No wonder *you couldn't read the fine print—you've got to use ultraviolet light!"*

Materials of Chemistry Find Practical Uses

Chemical Inventions Patented

Patents may be ordered by number from the Commissioner of Patents, Washington 25, D.C., at 25 cents a copy. Remittances should be sent in coin, money order, or U.S. Patent Office coupons, not stamps.

Cold Weather Goggles

➤ GOGGLES which do not fog up in cold weather have been invented by William R. Christensen, Newton Highlands, and Chester E. Cross, East Sandwich, Mass. Face-fitting, the goggles have, attached to their upper rims, four condensers which remove the moisture from the air circulating in the eye cavities, cool the air, and return it to the eye cavities.

The condensers, made from a heat-conducting metal such as copper, are divided into two channels, one for the body-heated moist air in the eye cavity to move upward, and the other for the cooled dry air to move back downward into the eye cavity. The moisture in the air collects on metal fins in the channels and freezes there. The condensers are cooled by the outside air. The inventors received patent number 2,615,162.

Radioactive Wastes

➤ WHAT TO DO with waste radioactive materials, produced at atomic energy plants, has been a problem of some concern. Now William S. Ginell, Levittown, N. Y., has come up with an invention which may take care of the problem. He has assigned it, patent number 2,616,847, to the Atomic Energy Commission.

Mr. Ginell points out that, under present methods, waste fission products of neutronic reactors must be stored for a long time until they lose their dangerous radioactivity. In some cases this takes years, and is quite expensive.

Mr. Ginell uses certain clays known as montmorillonite minerals. The mineral is brought into contact with the waste solution of radioactive cations to cause the cations to exchange with cations in the mineral. Thereafter the clay, now made radioactive, is heated to a temperature greater than 750 degrees Centigrade and up to about 1100 degrees. This prevents the process from being reversed, Mr. Ginell has discovered. The radioactive clay can then be stored in a bed of natural clay.

Fire Retardant

➤ A FIRE retardant to protect combustible materials has been invented by Dr. Walter Juda, Cambridge, Mass. His patent, number 2,616,866, has been assigned to Pyrotron Development Corp., New York. The retardant is prepared by directly reacting phenol with sulfonic acid, and by reacting the resulting reaction product directly with urea.

Such compounds, being formed by direct chemical reaction of the components only, are substantially free

of inorganic compounds in the reaction products obtained.

For Radioactive Ores

➤ RADIOACTIVE ores are separated according to their degree of radioactivity with an apparatus invented by Christian M. Lapointe, Port Radium, Northwest Territories, Canada. The patent, number 2,617,526, is assigned to Eldorado Mining and Refining, Ltd., Ottawa.

This sorting process takes place after the preliminary separation of waste materials and after the ore has been crushed and sized. The ore is fed, piece by piece, on a conveyor belt past a Geiger counter. The impulses of radioactivity received from the ore by the Geiger counter are translated into electrical energy which activates the sorting mechanism—thus segregating the pieces of ore with high radioactivity.

T.V. Color Screen

➤ LEE DE FOREST, Los Angeles, the "father of radio," received a patent recently for a new kind of color screen for color television. It is number 2,617,875 and it is assigned to the Allen B. Du Mont Laboratories, Clifton, N. J. Other screens, he says, are divided into three, pie-like pieces, each transmitting one of the three primary colors. His screen is divided into many small areas of the three primary colors.

Rocket Pictures

➤ A WAY of taking continuous pictures of a high speed, experimental rocket, moving along a track, without moving the camera has been invented.

Previous difficulty has been that the track is too long to get the entire trip of the rocket onto film without "panning" the camera. At such high speeds, this is hard to do. Nevertheless, pictures are important in research work on rockets.

Dick R. Herman, Los Angeles, Calif., has invented a way of taking care of this. He has assigned his patent, number 2,618,195, to Northrop Aircraft, Inc., Hawthorne, Calif.

His camera views a bank of mirrors placed one above the others in the picture frame and independently adjusted so that a different portion of the rocket's track is seen in each mirror. In one particular set-up, the camera took constant pictures of the passage of a rocket along a track 1,850 feet long, using nine mirrors aimed at nine sections of the track.

Atomic Energy Signals

➤ A SOURCE of atomic energy carried on the end of a railroad train can operate railroad signals indicating whether the track is clear. The inventors, Ernst Vogt, Wallisellen, and Walter Gerhard Heilpern, Zurich, Switzerland, propose that there be attached to the last car of a train a source of gamma radiation such as uranium, actinium, thorium or manufactured radioactive materials. A lead shield would direct the gamma rays. When the last car passed through the end of one section, the rays would strike Geiger-Muller detection tubes placed at the side of the track. This would activate switches, changing, the railroad signal lights for any trains behind. The patent, number 2,620,435, has been assigned to Societe Technique pour l'Industrie Nouvelle S. A., or "Stin," Vevey, Switzerland.

Ear Protector

➤ THE EVER-INCREASING noise of our civilization can be stopped from harming the ear with an aural protective device, according to its inventor, Lee T. Reynolds, Hollywood, Calif. Furthermore, the device stays open during sounds of a normal level. It consists of an ear tube with a flutter valve mounted on two hair springs. When a dangerously loud noise occurs, the valve is pushed by the high air pressure far enough inward to close the ear tube so the pressure does not get to the ear drum. Similarly, a sudden or abrupt decrease of air pressure, as in the wake of a pressure wave, pulls the flutter valve outward, sealing the outer end of the tube. This protects the ear drum from the sudden decrease in air pressure. Patent number is 2,619,960.

Better Peeled Potatoes

➤ POTATOES may be peeled before shipping and still keep their pristine whiteness by a method invented by Corrado Scalera, Providence, R. I. Previous methods, the inventor says, required that the potatoes be sealed in airtight containers and that they be dunked into a sulfur dioxide solution which sometimes formed a hard crust on the potato. His method does away with these deficiencies, he says. The potatoes are dipped into a solution made of 30 gallons of water, one pound of sodium sulfite and one-half pound of citric acid crystals. It is maintained at 40 degrees Fahrenheit. This treatment keeps the potatoes white, permits storage and handling in crates or bags, provided the potatoes are held at the 40-degree temperature. The patent, one-half of which was assigned to Anthony Longo, Cranston, R.I., is numbered 2,620,277.

Jet Fire Prevention

➤ JET PLANE engines generate considerable heat and overheating is dangerous, sometimes resulting in fires. A heat detector, newly invented, promises to give the alarm to the pilot quickly if there are any abnormal temperature rises in the jet engine. The inventors, Phillip J. Cade, Winchester, and Donald J. MacDougall, Framingham, Mass., claim that previous methods, such as thermocouples, delay the alarm too long. Also, too many of them are required for efficient operation.

By use of a photocell, the inventors say these objections can be done away with. The detector is a three-electrode lead sulfide photocell. The three electrodes lie in contact with a semi-conductive lead sulfide film which becomes more conductive when exposed to radiation. Several of these cells are connected with an alarm system. The patent, number 2,621,239, has been assigned to Photoswitch, Inc., Cambridge, Mass.

Radiant Energy Protection

➤ GLASS FIBERS with a very high content of lead can be woven into a fabric which will provide a good degree of protection to persons working around X-ray machines or other emitters of radiant energy. Vincent W. Archer, Charlottesville, Va., has assigned to the Research Corporation, New York, his invention, patent number 2,623,549, for a radiant energy opaque fabric. Mr. Archer has found that lead glass fibers provide the wearer with a lead equivalent of approximately 0.19 millimeter.

Book Condensations

A History of Science: Ancient Science Through the Golden Age of Greece — George Sarton — *Harvard University Press,* 646 p., illus., $10.00. The intention of the author in this book was to reproduce not only the letter, but the spirit of his lectures which have captivated so many audiences.

The Advancement of Science, Vol. IX, No. 34, September, 1952—*British Association for the Advancement of Science,* 163 p., illus., paper, six shillings. Containing the addresses of the president, and the presidents of the sections at the centennial meeting of the Association.

Theory of Electric Polarisation C. J. F. Böttcher—*Elsevier,* 492 p., $10.00 For advanced students and experimental workers in both chemistry and physics. Written directly in English by the professor of physical chemistry at the University of Leyden, Netherlands.

Advancements in Wood Research and Timber Engineering — *Timber Engineering Company,* 31 p., illus., paper, free upon request direct to publisher, 1319 18th St., Washington 6, D. C. Describing research in the use and treatment of wood.

General and Inorganic Chemistry —P. J. Durrant—*Longmans, Green,* 2d ed., 671 p., illus., $4.50. Important additions in this new edition are two new chapters on colloids and nuclear chemistry.

The Atomic Energy Act of 1946 with Amendments through the Eighty-Second Congress—Joint Committee on Atomic Energy, Carl T. Durham, Chairman—*Govt. Printing Office,* 83 p., paper, free upon request to the House Document Room, U. S. Capitol, Washington 25, D. C. A collection of statutory material concerning the development and control of atomic energy.

Quantitative Analysis — William Marshall MacNevin and Thomas Richard Sweet—*Harper,* 247 p., illus., $3.75. A short text with experiments selected for the needs of chemistry majors, and pre-medical and pre-pharmacy students.

Pavement-Marking Materials—William H. Goetz, Chairman — *National Academy of Sciences-National Research Council,* Highway Research Board Bulletin 57, 128 p., illus., paper, $1.80. Reporting research and tests of materials used for this purpose.

Occupational Diseases Associated With the Importation of Raw Materials—Daniel C. Braun and John F. Osterritter — *Mellon Institute,* 5 p., paper, free upon request direct to publisher, 4400 Fifth Ave., Pittsburgh 13, Pa. Discussing infections and infestations as well as articles producing allergic reactions.

Neomycin: Nature, Formation, Isolation, and Practical Application—Selman A. Waksman with the collaboration of Hubert A. Lechevalier and others—*Rutgers University Press,* 219 p., illus., $4.00. Neomycin was isolated at the Department of Microbiology, Rutgers, in 1949 from a culture of *Streptomyces fradiae,* and was found to have marked activity against various bacteria.

Proudly Presented

➤ TREATMENT of cellulose wih a peroxygen compound before dissolving it in a salt solution will produce low viscosity solutions at relatively high solids content, according to Becco Bulletin No. 43 published by the Buffalo Electro-Chemical Co., Buffalo 7, N. Y., entitled "Treatment of Cellulose Derivatives with Peroxygen Compounds." The resulting stable preparations are useful as cellulose finishes for textiles.

➤ A CLAMP which will hold a thermometer or a pipette at any desired distance from the wall of a water bath can be clamped to the side of the vessel and adjusted without removing clamp from wall or object from clamp. It is offered by Labline, Inc., 217 N. Desplaines St., Chicago 6, Ill.

➤ A VERTICAL ROD can be clamped to a table or any type of flat surface can be held securely by a new clamp furnished by Labline, Inc. Their new Alumaloy adjustable "C" clamp is fully adjustable from $\frac{3}{8}$" to 72" or more. The jaw opening is limited only by the length of the rod used as a spacer.

➤ WHEN THE LOAD is placed on the pan of Fisher Scientific Co.'s Gramatic Balance, weights are removed to restore balance. Information and prices can be obtained from your nearest Fisher representative, in Pittsburgh, New York, Washington, St. Louis, Montreal or Toronto.

➤ FISHER Development Laboratories of the Fisher Scientific Co. have produced a Semi-Micro Centrifuge designed for smooth operation, stability and safety. They recommend it especially for school laboratories. The announcement comes from 717 Forbes St., Pittsburgh 19, Pa.

➤ ATOM MODELS built to the scale of 100,000,000 to one, as designed by Dr. Joseph O. Hirschfelder of the University of Wisconsin and Dr. Hugh S. Taylor of Princeton University, have been joined by metal coordination models developed by Dr. J. C. Bailar of the University of Illinois and Dr. Fred Basolo of Northwestern University. Fisher Scientific Co., 717 Forbes St., Pittsburgh, Pa., distributors of both sets of models, offer for the asking a new 12-page booklet describing the uses of these models in teaching stereochemistry.

➤ THE LONG NECK of the Kjeldahl flask no longer complicates later titration, because Fisher Scientific Co. has just brought out an improved model whose neck is removable. By means of a standard taper joint, it can also be replaced by a reflux condenser. The new flask, designed by Dr. William Rieman III of Rutgers, may be ordered from 717 Forbes St., Pittsburgh 19, Pa., or other locations of the Fisher Scientific Co.

➤ HIGH VACUUM installations may be planned with the aid of Bulletin 10E of Central Scientific Co., 1700 Irving Park Road, Chicago 13, Ill. This 56-page book includes valuable tables and charts as well as descriptions of new type apparatus and accessories.